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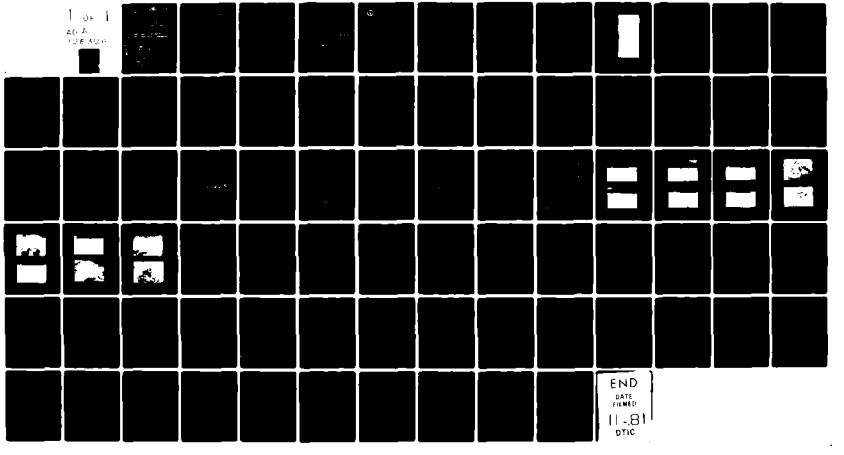

LEVEL II

MISSOURI-KANSAS CITY BASIN

AD A106306

JOHNSON COUNTY DAM A-26

JOHNSON COUNTY, MISSOURI

MO 20073

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

United States Army
Corps of Engineers
Serving the Army
Serving the Nation

St. Louis District

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

JUNE 1980

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National Dam Safety Program
Johnson Co. #A-26 Dam (MO 20073)
Johnson County, Missouri

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This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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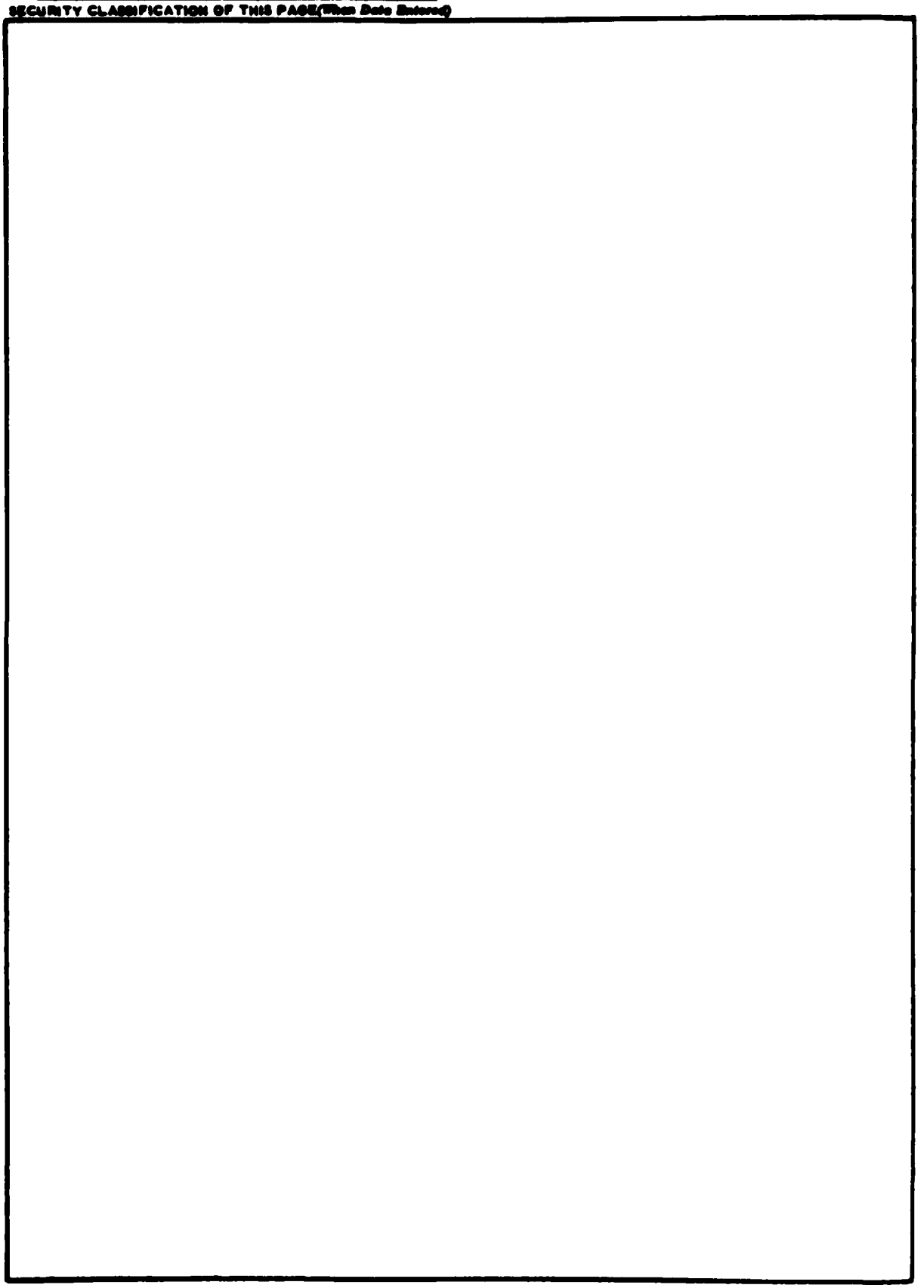

MISSOURI-KANSAS CITY BASIN

JOHNSON COUNTY DAM A-26

JOHNSON COUNTY, MISSOURI

MO 20073

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

United States Army
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St. Louis District

PREPARED BY: U.S. ARMY ENGINEER DISTRICT. ST. LOUIS

FOR: STATE OF MISSOURI

JUNE 1980

DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD, NORTH
ST. LOUIS, MISSOURI 63101

REPLY TO ATTENTION OF

SUBJECT: Johnson County Dam A-26 Mo. ID No. 20073
Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Johnson County Dam A-26.

It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

a. Spillway will not pass 50 percent of the Probable Maximum Flood without overtopping the dam.

b. Overtopping of the dam could result in failure of the dam.

c. Dam failure significantly increases the hazard to loss of life downstream.

SUBMITTED BY: _____ 29 SEP 1980
Chief, Engineering Division — Date

APPROVED BY : _____ 30 SEP 1980
Colonel, CE, District Engineer — Date

JOHNSON COUNTY A-26 DAM

JOHNSON COUNTY, MISSOURI

MISSOURI INVENTORY NO. 20073

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

PREPARED BY:

BLACK & VEATCH
CONSULTING ENGINEERS
KANSAS CITY, MISSOURI

UNDER DIRECTION OF

ST. LOUIS DISTRICT CORPS OF ENGINEERS

FOR

GOVERNOR OF MISSOURI

JUNE 1980

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam	Johnson County Dam A-26
State Located	Missouri
County Located	Johnson County
Stream	Tributary to South Fork Blackwater River
Date of Inspection	26 June 1980

Johnson County Dam A-26 was inspected by a team of engineers from Black & Veatch, Consulting Engineers for the St. Louis District, Corps of Engineers. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and state agencies, professional engineering organizations, and private engineers. Based on these guidelines, this dam is classified as a small size dam with a high downstream hazard potential. According to the St. Louis District, Corps of Engineers, failure would threaten lives and property. The estimated damage zone extends approximately one mile downstream of the dam. Within the estimated damage zone are two residences, a county highway, and a 380 acre water supply reservoir. Contents of the estimated damage zone were verified by the inspection team.

Our inspection and evaluation indicates the spillways do not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. The spillways will not pass the probable maximum flood without overtopping but will pass 20 percent of the probable maximum flood. The spillway will also pass the one percent probability flood (100-year). The spillway design flood recommended by the guidelines is 50 to 100 percent of the probable maximum flood. Considering the small volume of water impounded behind the dam, the valley below the dam and the hazard zone, the spillway design flood should be 50 percent of the probable maximum flood. The probable maximum flood is defined as the flood discharge which may be expected from the most severe combination of critical meteorologic and hydrologic conditions which are reasonably possible in the region.

Based on visual observations, this dam appears to be in satisfactory condition. Deficiencies visually observed by the inspection team were severe erosion and sloughing on upstream face due to wave action, embankment erosion at the inlet and outlet ends of the principal spillway, a few animal burrows evident in the embankment and a few small trees growing on the embankment. Seepage and stability analyses required by the guidelines were not available.

There were no observed deficiencies or conditions existing at the time of the inspection which indicated an immediate safety hazard. Future corrective action and regular maintenance will be required to correct or control the described deficiencies. In addition, detailed seepage and stability analyses of the existing dam, as required by the guidelines, should be performed. A detailed report discussing each of these deficiencies is attached.

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Illinois 62-29261

Edwin R Burton

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Harry L Callahan

Harry L. Callahan, Partner
Black & Veatch

OVERVIEW OF DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
JOHNSON COUNTY DAM A-26

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SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the District Engineer of the St. Louis District, Corps of Engineers, directed that a safety inspection of the Johnson County Dam A-26 be made.

b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams." These guidelines were developed with the help of several Federal agencies and many state agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances.

(1) The dam is an earth structure located in the valley of a tributary to South Fork Blackwater River (Plate 1). The watershed is an area of low hills containing timber, grassland, terraced cropland and small farm ponds (Plate 2). The dam is approximately 1,200 feet long along the crest and 25 feet high. The dam crest is 12 feet wide. The downstream face of the dam slopes from the crest to the valley floor below.

(2) The principal spillway from the lake is an uncontrolled 24-inch corrugated metal pipe with a 30-inch corrugated metal pipe drop inlet installed in the embankment. The drop inlet is 11 feet deep and is protected by a trash rack and antivortex baffle plate. Flow through the pipe discharges freely into a plunge pool and the natural stream channel below. The emergency spillway consists of a 40-feet wide trapezoidal cut with 3H to 1V side slopes in the natural overburden around the right end of the embankment. The emergency spillway channel below the dam is confined between two dikes. Discharge through the emergency spillway overflows to the natural stream below the dam.

(3) Pertinent physical data are given in paragraph 1.3.

b. Location. The dam is located in West-central Johnson County, Missouri, as indicated on Plate 1. The lake formed by the dam is in an area shown on the United States Geological Survey 7.5 minute series quadrangle map for Elm, Missouri in Section 36 of T46N, R29W.

c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. Based on these criteria, the dam and impoundment are in the small size category.

d. Hazard Classification. The hazard classification assigned by the Corps of Engineers for this dam is as follows: The Johnson County A-26 Dam has a high hazard potential, meaning that the dam is located where failure may cause loss of life, and serious damage to homes, agricultural, industrial and commercial facilities, and to important public utilities, main highways, or railroads. For the Johnson County Dam A-26 the estimated flood damage zone extends approximately one mile downstream of the dam. Within the estimated damage zone are two residences, a county highway, and a 380 acre water supply reservoir. The inspection team verified the contents of the downstream hazard zone.

e. Ownership. The dam is owned by Mr. Chester Spiwak, Box 152, Kingsville, Missouri, 64061, Telephone 816-597-3427.

f. Purpose of Dam. The dam forms a 18.6 acre lake used for flood control and soil conservation.

g. Design and Construction History. The dam was designed by the Johnson County Soil Conservation Service. The dam was constructed in 1966 by Clark and Farmer Construction Co., Inc.

h. Normal Operating Procedure. Normal rainfall, runoff, transpiration, evaporation, and overflow through the uncontrolled outlet pipe all combine to maintain a relatively stable water surface elevation.

1.3 PERTINENT DATA

a. Drainage Area - 425 acres

b. Discharge at Damsite.

(1) Normal discharge at the damsite is through an uncontrolled 24-inch outlet pipe.

(2) Estimated experienced maximum flood at damsite - Unknown.

(3) Estimated ungated spillway capacity at maximum pool elevation 590 cfs (50 Percent Probable Maximum Flood Pool El.900.5).

c. Elevation (Feet above m.s.l.).

(1) Top of dam - 899.6 (see Plate 3)

(2) Emergency spillway crest - 897.3

(3) Principal spillway drop inlet crest - 894.0

(4) Streambed at toe of dam - 875.0

(5) Maximum tailwater - Unknown.

d. Reservoir.

(1) Length of maximum pool - 2,300 feet ± (Probable maximum flood pool level)

(2) Length of normal pool - 1,600 feet ± (Principal spillway drop inlet crest)

e. Storage (Acre-feet).

(1) Top of dam - 248

(2) Emergency spillway crest - 174

(3) Principal spillway drop inlet crest - 98

(4) Design surcharge - 241 (El. 899.4, from SCS "As-Builts")

f. Reservoir Surface (Acres).

(1) Top of dam - 36.0

(2) Emergency spillway crest - 28.2

(3) Principal spillway drop inlet crest - 18.6

g. Dam.

(1) Type - Earth embankment

(2) Length - 1,200 feet

(3) Height - 25 feet ±

(4) Top width - 12 feet

(5) Side slopes - upstream face 1.0 V on 2.5 H, downstream face between 1.0 V on 1.9 H and 1.0 V on 3.0 H (see Plates 4 and 5)

(6) Zoning - Unknown.

(7) Impervious core - None.

(8) Cutoff - Core Trench (see Plate 4).

(9) Grout curtain - None.

h. Diversion and Regulating Tunnel - None.

i. Principal Spillway.

(1) Type - 24-inch corrugated metal pipe with a 30-inch corrugated metal pipe drop inlet.

(2) Drop inlet crest elevation - 894.0 feet m.s.l.

(3) Inlet invert elevation - 883.0 feet m.s.l.

(4) Outlet invert elevation - 877.0 feet m.s.l.

(5) Gates - None.

(6) Upstream channel - Not applicable.

(7) Downstream channel - Plunge pool to natural open channel.

j. Emergency Spillway.

(1) Type - Grass open channel.

(2) Width of channel - 40 feet.

(3) Emergency spillway crest - 897.3.

(4) Gates - None.

(5) Upstream channel - Grass lined channel upstream of crest.

(6) Downstream channel - Natural stream channel below the dam.

k. Regulating Outlets - None.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

Design data in the form of a detailed geologic site investigation report, a design memorandum from a SCS engineer with design recommendations, "As-Built" drawings, construction records, design file, and hydrologic/hydraulic calculations were made available by the State Convervationist of the USDA Soil Conservation Service. The geologic report, design memorandum, and Hydrologic data are included in Appendix B and C.

2.2 CONSTRUCTION

Construction records in the form of construction logs and "As-Built" drawings were made available for review by the Soil Conservation Service. The dam was constructed in 1966 by Clark and Farmer Construction Co., Inc. There were no major or unusual construction problems recorded in the construction log. Pertinent information from the "As-Built" drawings is shown on Plates 3, 4, and 6.

2.3 OPERATION

Documentation of operation, maintenance or past floods was not available.

2.4 GEOLOGY

The site of the dam and reservoir is located in a broad shallow valley. The dam impounds an intermittent tributary of the South Fork Blackwater River.

The soils in the area of the dam and reservoir consist of the Haig, Deepwater, Sampsel, and Zook soil series. The Haig soils are located on uplands and are formed in loess. They are classified for engineering purposes as low to high-plastic clay (CL or CH). The Deepwater and Sampsel soils are located on hill sides and are formed in residuum from shale. They are classified for engineering purposes as low-plastic silt (ML) or low-plastic clay (CL). The Zook soils are located along the floodplain of the stream and are formed in alluvium. They are classified for engineering purposes as low-plastic silt (ML) and low-plastic clay (CL).

The bedrock in the area of the dam and reservoir consists of shale of the Marmaton Group of the Des Moinesian Series, the Pennsylvanian System. According to design memoranda and "As-Built" construction drawings, the bedrock underlying the dam is a yellowish brown and gray

shale. The shale is covered by 6 to 7 feet of residual or alluvial soils. The core trench was cut through weathered shale into fresh shale.

2.5 EVALUATION

a. Availability. Engineering data were obtained from the Soil Conservation Service as noted in Section 2.1.

b. Adequacy. Engineering data were available from which to make an assessment of the design, construction, and operation. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

c. Validity. The available engineering data on the design, construction, and operation were determined to be valid.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of Johnson County Dam A-26 was made on 26 June 1980. The inspection team included professional engineers with experience in dam design and construction, hydrology, hydraulic engineering, and geotechnical engineering. The inspection team consisted of Edwin Burton, team leader; Robert Pinker, geologist; Gary Van Riessen, geotechnical engineer; Andrew Dywan, civil engineer; Thomas Rutherford, hydrologist; and Bill Fish, surveyor. Specific observations are discussed below. No observations were made of the condition of the upstream face of the dam below the pool elevation at the time of the inspection.

b. Dam. The inspection team observed the following conditions at the dam. Severe erosion and sloughing were observed on the upstream slope of the embankment. In places the under cutting of the silty clay material had progressed to within 15 feet of the crest, and vertical faces measuring about 2-1/2 feet were observed. The downstream slope was in satisfactory condition. No cracks were observed in the crest, upstream or downstream slopes of the embankment. No instruments to measure the performance of the dam were located.

There was no evidence of seepage in the embankment, foundation or abutments. No toe drains or relief wells were observed.

The embankment slopes and crest have a protective grass cover. The downstream slope was noted to be very dense. However, vehicles have worn tracks through the grass cover on the crest. A few small trees up to 1-inch diameter are growing on the dam. No evidence was found to indicate that the embankment had ever been overtopped.

Evidence that a maintenance program was in effect included the good condition of the grass cover and presence of only a few small animal burrows on the upstream and downstream slopes. The upstream drainage area to the lake contains timber, grassland, terraced cropland and some small farm ponds in an area of low hills. The lake contains a minor amount of siltation as determined by the growth of water lilies at each end of the dam.

c. Appurtenant Structures. The inspection team observed the following items pertaining to appurtenant structures. The principal spillway consists of an uncontrolled 24-inch asphalt coated corrugated metal pipe with a 30-inch corrugated metal pipe drop inlet installed in

the embankment. The drop inlet is protected by an SCS standard trash-rack and antivortex baffle plate. About 20 feet of the spillway pipe outlet was exposed and the pipe exterior was found to be in good condition. The 24-inch pipe was inspected from the downstream end and found to have no noticeable misalignment. The interior of the 30-inch drop inlet pipe was also found to be in satisfactory condition. No evidence of leakage was noted into, out of or around the spillway pipe. The pipe joints themselves could not be observed and the majority of the spillway pipe was considered unobservable. Some erosion was observed at both the inlet and outlet of the spillway pipe.

The emergency spillway consists of a 40 feet wide cut in the natural overburden around the right end of the dam. The spillway channel has a good unmowed grass protective cover and no evidence of erosion was observed. There was also no evidence of erosion upstream or downstream of the spillway. It should be noted that an abnormally large spillway disharge would probably not damage the embankment because it is protected by a training dike.

There was no development in the emergency spillway area which could suffer damage due to flow through the spillway.

d. Geology. The soils in the area of the dam and reservoir were formed in loess, residum from shale and alluvium. The soils formed in loess are located along the upland above the right abutment. The soils formed in residuum are located along the hill slopes around the reservoir. The soils formed in alluvium are located along the downstream channel below the dam.

No outcrops were observed in the area of the dam and reservoir. The bedrock in the foundations and the abutments is anticipated to be shale as shown on the "As-Built" construction drawings.

Samples of the embankment were taken near the center of the downstream crest. The material in the embankment consists of silty clay (CL). Based on these samples, the design memoranda and visual observations, it is anticipated the embankment consists of silty clay of low plasticity (CL).

e. Reservoir Area. No slumping or slides of the reservoir banks were observed.

f. Downstream Channel. No slumping or slides were observed in the downstream channel. The principal spillway pipe discharges to a plunge pool which flows into the natural stream channel. The channel downstream of the plunge pool is tree and brush lined.

3.2 EVALUATION

The various deficiencies observed at the time of the inspection are not believed to represent an immediate safety hazard. They do, however, warrant monitoring and control. The absence of riprap on the face of the dam has resulted in serious wave action erosion of the embankment. If not corrected, wave action will continue to erode the embankment and could lead to slope stability problems. The growth of small trees and brush and the uncut grass is not presently a serious problem; however, if allowed to go unchecked it could cause deterioration of the embankment. The roots of trees can loosen the embankment material and also can leave voids through which water can pass. Brush on the dam prevents inspection of the embankment and kills the smaller grasses whose roots are more effective in protecting the surface soil of the slope from erosion. The brush and tall uncut grass provides habitat for burrowing animals which can damage the embankment. The material eroded at the inlet and outlet ends of the primary spillway pipe should be replaced with suiable compacted backfill. Burrowing animals will continue to damage the embankment if no program is undertaken to eliminate them. Piping failure of the embankment has resulted in similar small earth dams due to burrowing animal damage.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The pool is primarily controlled by rainfall, runoff, evaporation, transpiration, and capacity of the uncontrolled principal spillway outlet pipe.

4.2 MAINTENANCE OF DAM

The existing maintenance program which is the responsibility of the Watershed District is evidenced only by the good condition of the grass cover on the embankment. No mowing has been done.

4.3 MAINTENANCE OF OPERATING FACILITIES

No operating facilities exist.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

For this dam, there is no existing warning system or preplanned scheme for alerting downstream residents.

4.5 EVALUATION

The maintenance program should be expanded to include mowing the grass cover on the embankment in order to discourage animal burrowing. The brush and trees on the embankment should be removed more frequently. Measures to correct the erosion on the upstream slope include placing of suitable bedding material then riprap. Also suitable backfill material should be placed at the inlet and outlet of the spillway pipe. A program should be undertaken to eliminate the burrowing animals.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. Design data pertaining to hydrology and hydraulics in the form of "As-Built" drawings and hydrologic/hydraulic calculations were provided by the Soil Conservation Service.

b. Experience Data. The drainage area and lake surface area are taken from design data supplied by the SCS and from the U.S.G.S. Elm Quadrangle Map. The spillway and dam layout is from "As-Built" drawings. Elevations observed by field survey during the inspection are noted on Plates 3 through 6.

c. Visual Observations.

(1) The principal spillway appears to be in good condition. The lake level at the time of the inspection was below the drop inlet level and there was no flow through the pipe. Only the inlet and outlet ends were observable. The spillway pipe discharges with a free outfall into a natural channel. There were no obstructions to flow in the downstream channel.

(2) The emergency spillway channel is in good condition with no evidence of erosion at the time of the inspection.

(3) Spillway discharges do not endanger the integrity of the dam.

d. Overtopping Potential. The spillways will not pass the probable maximum flood without overtopping the dam. The probable maximum flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The spillways will pass 20 percent of the probable maximum flood without overtopping the dam and will also pass the one percent probability flood which is estimated to have a peak outflow of 104 cfs developed by a 24-hour, one percent probability rainfall. According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, a high hazard dam of small size should pass 50 to 100 percent of the probable maximum flood. Considering the volume of water impounded by the dam and the downstream hazard, the appropriate spillway design flood should be 50 percent of the probable maximum flood. The portion of the estimated peak discharge of the probable maximum flood overtopping the dam would be 4,770 cfs of the total discharge from the reservoir of 5,520 cfs. The estimated duration of overtopping is 6.4 hours with a maximum height of 1.4 feet. The portion of the estimated peak discharge of 50 percent of the probable maximum flood overtopping the dam would be

2,100 cfs of the total discharge from the reservoir of 2,690 cfs. The estimated duration of overtopping is 4.2 hours with a maximum height of 0.9 feet. Overtopping for these periods of time could jeopardize the embankment.

According to the St. Louis District, Corps of Engineers, the effect from rupture of the dam could extend approximately one mile downstream of the dam. Within the estimated damage zone are two residences, a county highway, and a 380 acre water supply reservoir. Contents of the estimated damage zone were verified by the inspection team.

There does not appear to be any flood plain regulations or other constraints in force to limit future downstream development. Contents of the downstream hazard zone were verified by the inspection team.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visual observations of conditions which affect the structural stability of this dam are discussed in Section 3, paragraph 3.1b.

b. Design and Construction Data. Available design data included recommendations for design from a SCS engineer, a summary report of the geologic investigation, and soil classification tests.

Available construction data included "As-Built" construction drawings and construction logs.

Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stablity analyses should be performed for appropriate loading conditions and made a matter of record.

Based upon material classificaion and soil boring data, it is anticipated that the stability of the dam exceeds the suggested factors of safety as given in Table 4 of the Guidelines. The slopes of the dam are consistent with recommended slopes for small homogeneous earthfill dams on stable foundations as given in the USBR "Design of Small Dams."

c. Operating Records. No operational records exist.

d. Post Construction Changes. No changes have been made since completion of the dam.

e. Seismic Stability. The dam is located in Seismic Zone 1 which is a zone of minor seismic risk. A properly designed and constructed earth dam using sound engineering principles and conservatism should pose no serious stability problems during earthquakes in this zone. The seismic stability of an earth dam is dependent upon a number of factors: embankment and foundation material classifications and shear strengths; abutment materials, conditions, and strengths; embankment zoning; and embankment geometry.

Adequate descriptions of embankment design parameters, foundation and abutment conditions, or static stability analyses to assess the seismic stability of this embankment were not available and therefore no inferences will be made regarding the seismic stability. An assessment of the seismic stability should be included as part of the stability analysis required by the guidelines.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. Several conditions observed during the visual inspection by the inspection team should be monitored and/or controlled. These are erosion of the front face of the embankment at normal lake level, erosion of the embankment at the inlet and outlet ends of the principal spillway, the growth of a few small trees on the embankment, and animal burrows in the embankment. The spillway capacity is inadequate to pass the recommended spillway design flood. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

b. Adequacy of Information. The conclusions in this report are based on performance history, visual conditions, and the available engineering design data. The inspection team considers that these data are sufficient to support the conclusions herein. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Urgency. It is the opinion of the inspection team that a program should be developed as soon as possible to implement remedial measures recommended in paragraph 7.2b. If the safety deficiencies listed in paragraph 7.1a are not corrected, they will continue to deteriorate and lead to a serious potential of failure. The alternatives recommended in paragraph 7.2a should be pursued on a high priority basis.

d. Necessity for Phase II. The Phase I investigation does not raise any serious questions relating to the safety of the dam nor does it identify any serious dangers which would require a Phase II investigation. However, the additional analyses noted in paragraph 2.5.b. are necessary for compliance with the guidelines.

e. Seismic Stability. This dam is located in Seismic Zone 1. Adequate description of embankment design parameters, foundation and abutment conditions, or static stability analyses to assess the seismic stability of this embankment was not available and therefore no inferences will be made regarding the seismic stability. An assessment of the seismic stability should be included as part of the recommended stability analysis.

7.2 REMEDIAL MEASURES

a. Alternatives. The emergency spillway size and/or height of the dam would need to be increased or the lake level would need to be lowered to increase available flood storage in order to pass the spillway design flood.

b. Operation and Maintenance Procedures. The following operation and maintenance procedures are recommended and should be carried out under the direction of an engineer experienced in the design, construction, and inspection of earth dams:

(1) Suitable bedding material then riprap should be placed on the upstream face of the dam at the normal lake level to prevent erosion of the embankment material.

(2) Suitable backfill material and riprap should be placed at the inlet and outlet of the spillway pipe.

(3) The animal burrows in the embankment should be corrected since they can lead to piping. The embankment slope should be monitored during this repair. Control measures should be implemented subsequent to repair.

(4) An improved maintenance program to remove and control the growth of brush and trees on the embankment should be developed. Grass cover on the embankments should be cut periodically.

(5) Seepage and stability analysis should be performed.

(6) A detailed inspection of the dam should be made periodically. More frequent inspections may be required if additional deficiencies are observed or the severity of the reported deficiencies increase.

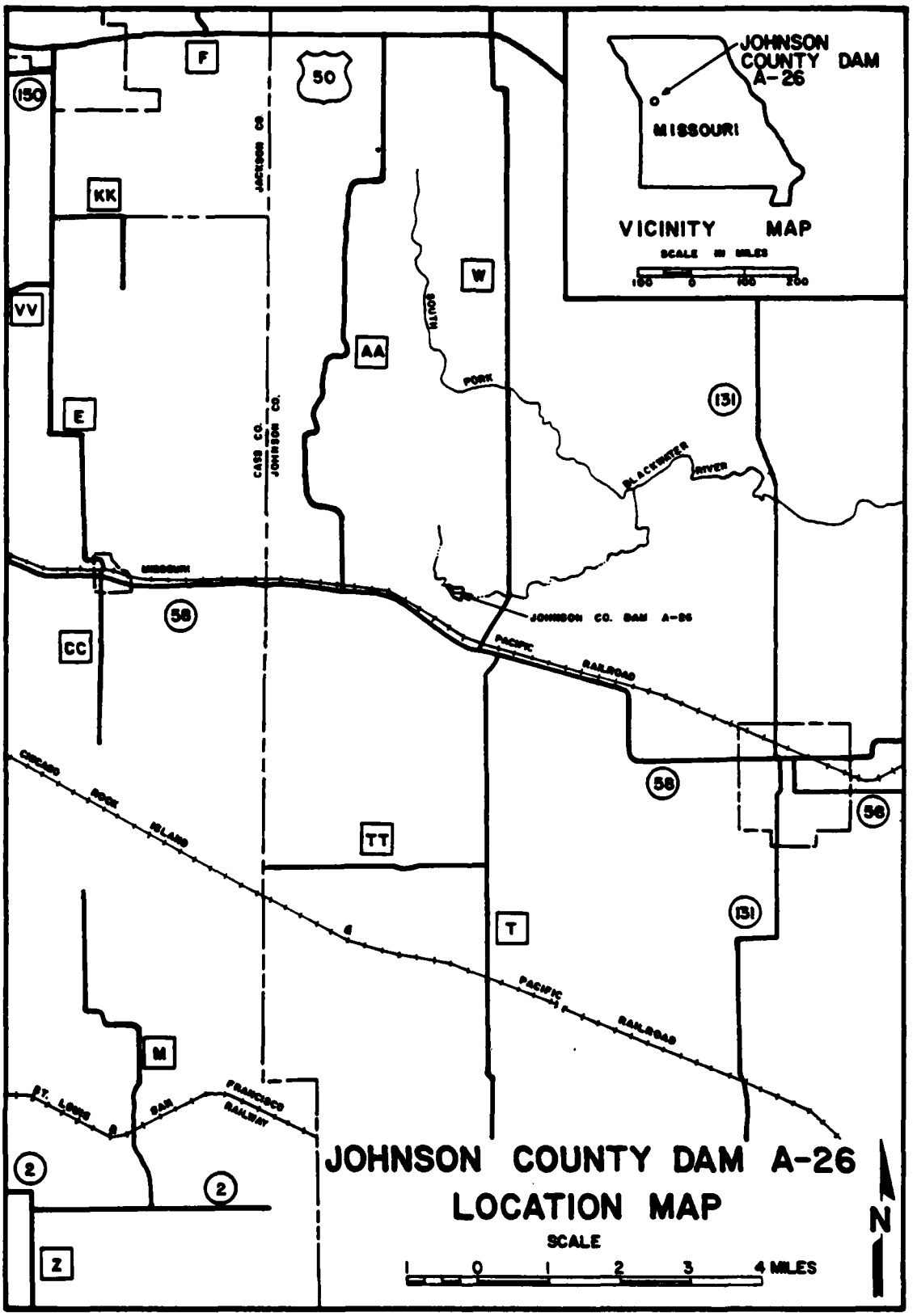

JOHNSON COUNTY DAM A-26
MISSOURI
VICINITY MAP
SCALE IN MILES
150
0
150
300
F
50
150
KK
JACKSON CO.
VV
W
AA
SOUTH
FORK
E
CASS CO.
JOHNSON CO.
131
BLACKWATER
RIVER
MISSOURI
58
JOHNSON CO. DAM A-26
CC
PACIFIC
RAILROAD
58
56
CHICAGO
ROCK
ISLAND
TT
T
131
PACIFIC
RAILROAD
M
ST. LOUIS
SAN
FRANCISCO
RAILWAY
2
2
Z
JOHNSON COUNTY DAM A-26
LOCATION MAP
SCALE
0
1
2
3
4 MILES
N

PLATE 1

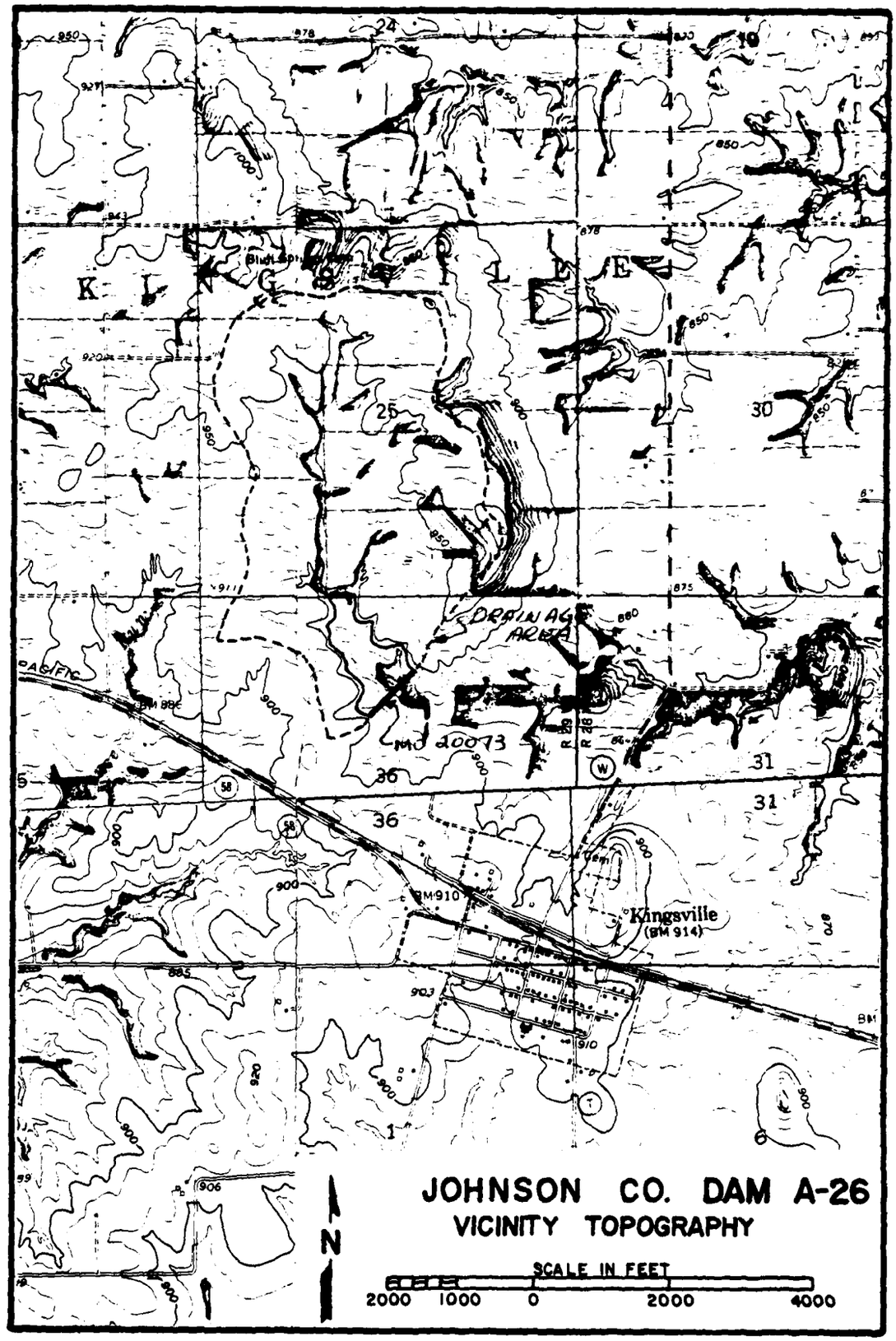

K I N G S V I L L E
DRAINAGE AREA
MO 20073
Kingsville
(BM 914)
BM 910
PACIFIC
N
JOHNSON CO. DAM A-26
VICINITY TOPOGRAPHY
SCALE IN FEET
2000 1000 0 2000 4000

PLATE 2

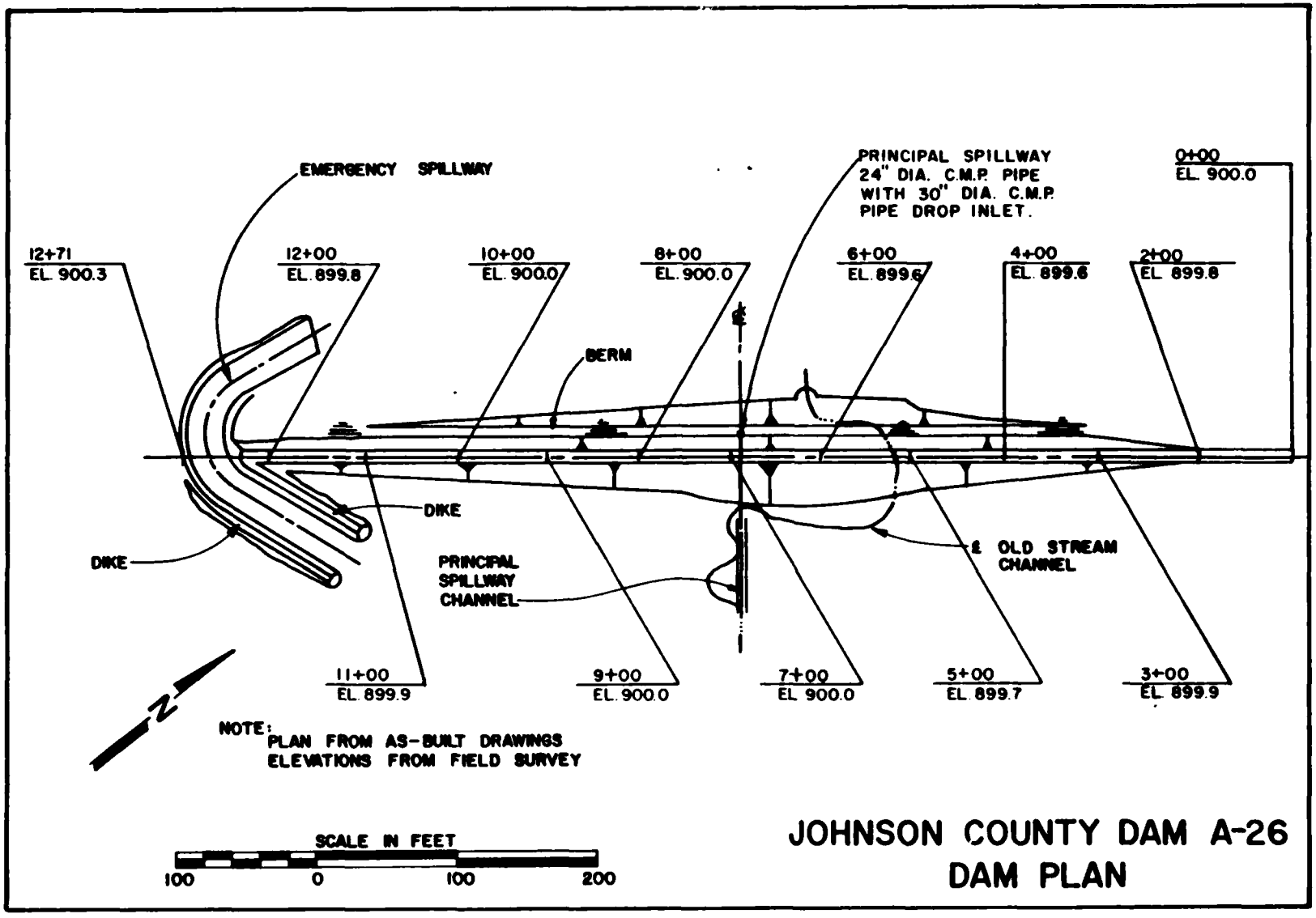
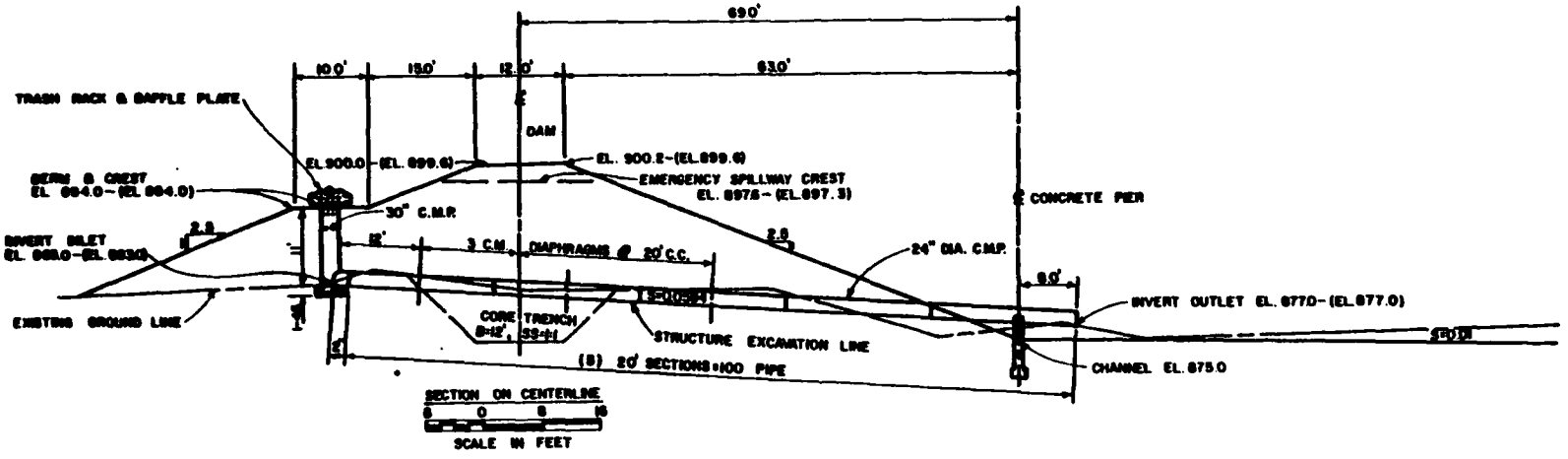


PLATE 3

JOHNSON COUNTY DAM A-26
DAM PLAN



NOTE:
ELEVATIONS IN PARENTHESES ARE FROM FIELD SURVEY. SECTION AND DETAILS FROM AS-BUILT DRAWINGS

JOHNSON COUNTY DAM A-26
PRINCIPAL SPILLWAY & DAM CROSS SECTION

PLATE 4

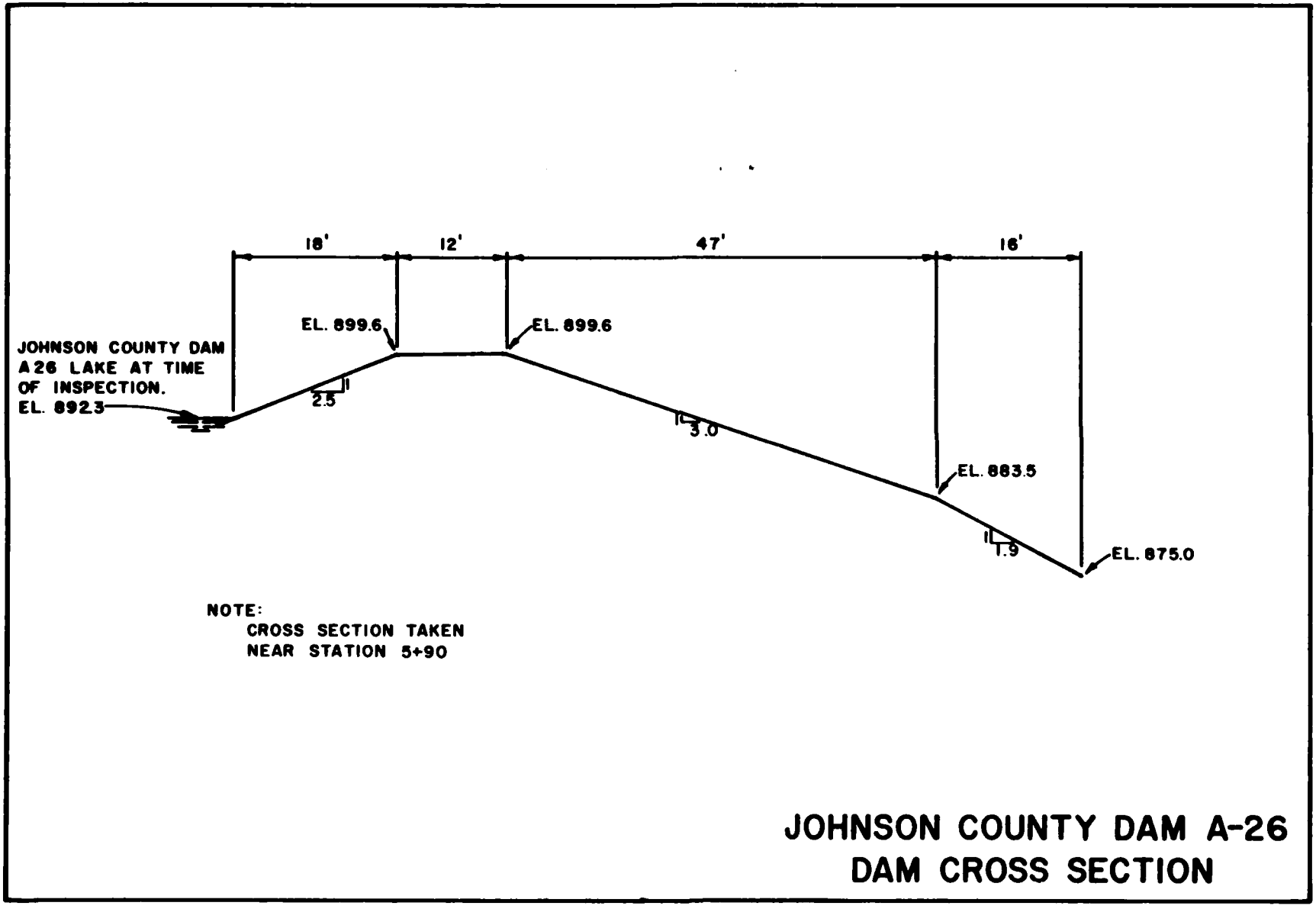
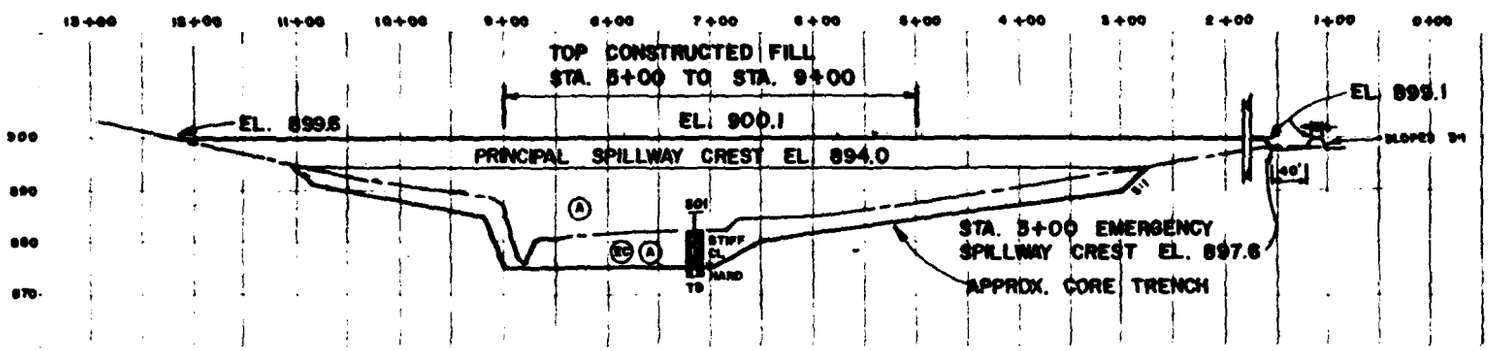
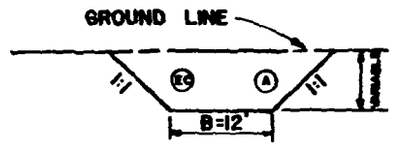


PLATE 5

JOHNSON COUNTY DAM A-26
DAM CROSS SECTION





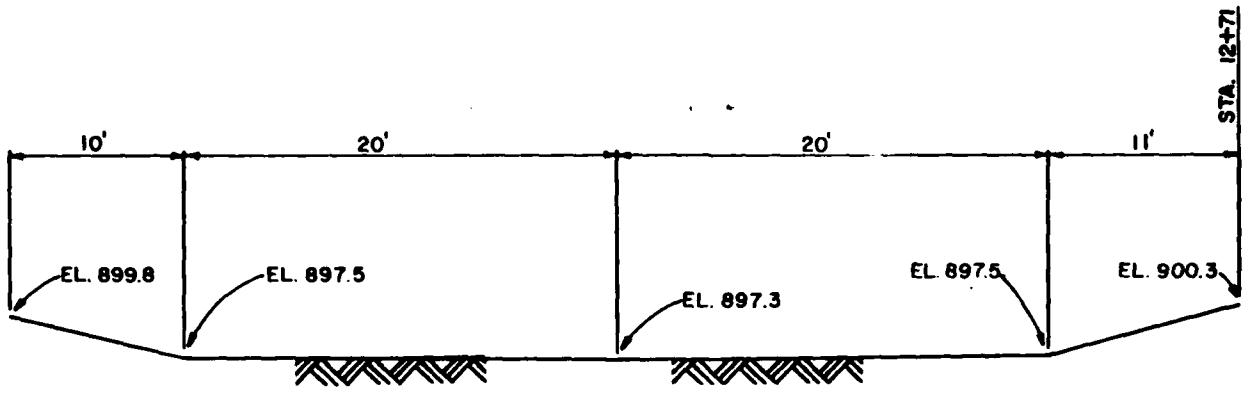
TYPICAL CORE TRENCH & STRUCTURE EXCA.

APPROX. CORE TRENCH	
STATION	ELEVATION
3+00	890.0
6+50	880.3
7+00	875.0
9+00	875.0
9+20	885.0
10+85	891.0

NOTE:
DAM PROFILE FROM
AS-BUILT DRAWINGS

PLATE 6

JOHNSON COUNTY DAM A-26
DAM PROFILE



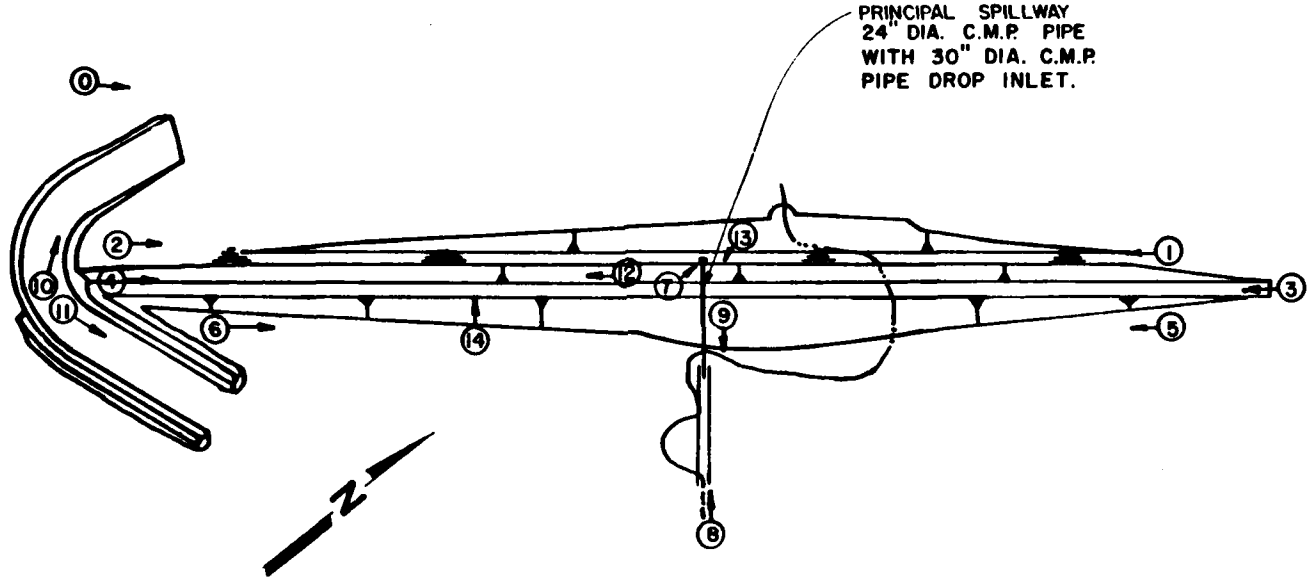
NOTE:
CROSS SECTION TAKEN
BETWEEN STATIONS 12+10
& 12+71 ALONG ℄ OF DAM
LOOKING DOWNSTREAM

PLATE 7

JOHNSON COUNTY DAM A-26
EMERGENCY SPILLWAY CROSS SECTION

LEGEND

(1) PHOTO NO. & DIRECTION



JOHNSON COUNTY DAM A-26
PHOTO INDEX

PLATE 8

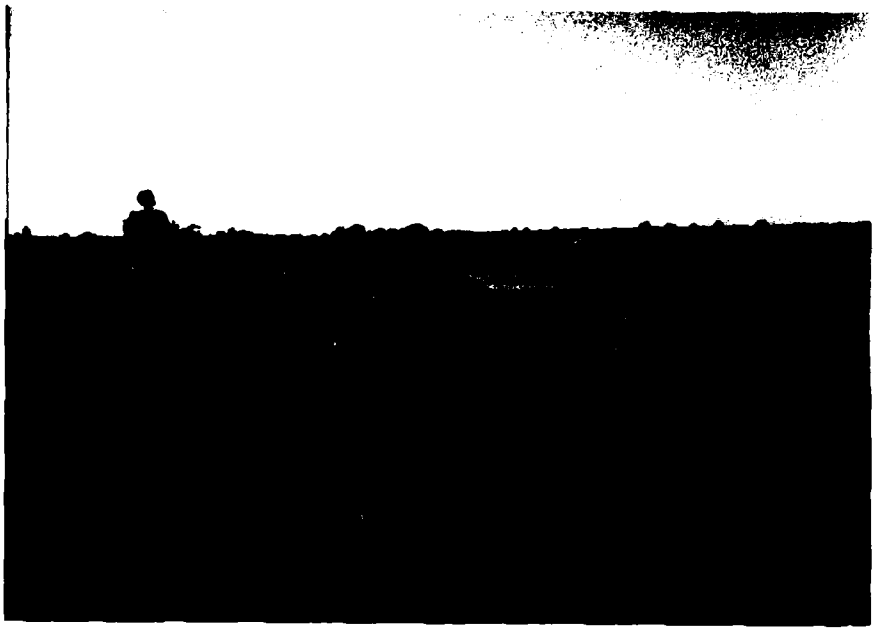


PHOTO 1: UPSTREAM FACE OF DAM LOOKING WEST

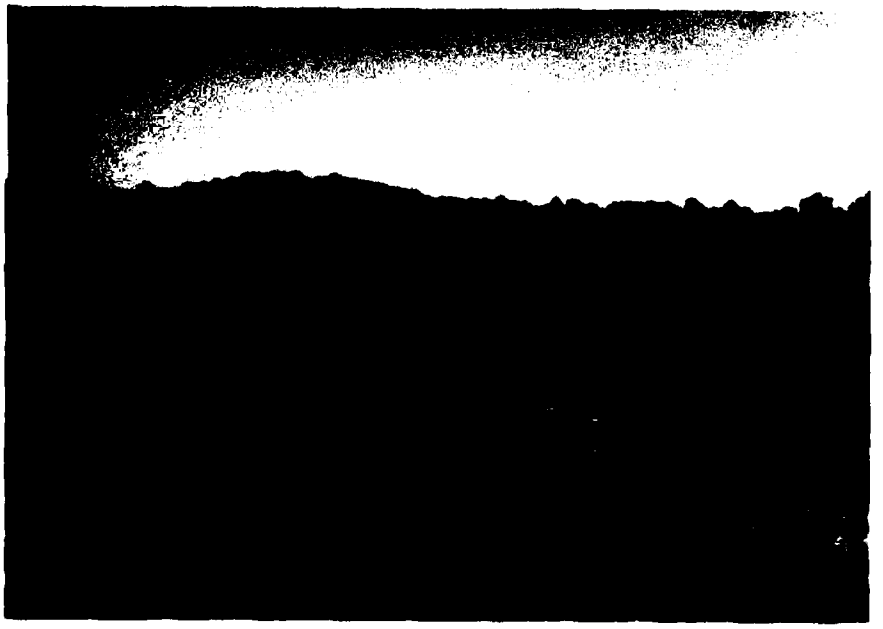


PHOTO 2: UPSTREAM FACE OF DAM LOOKING EAST

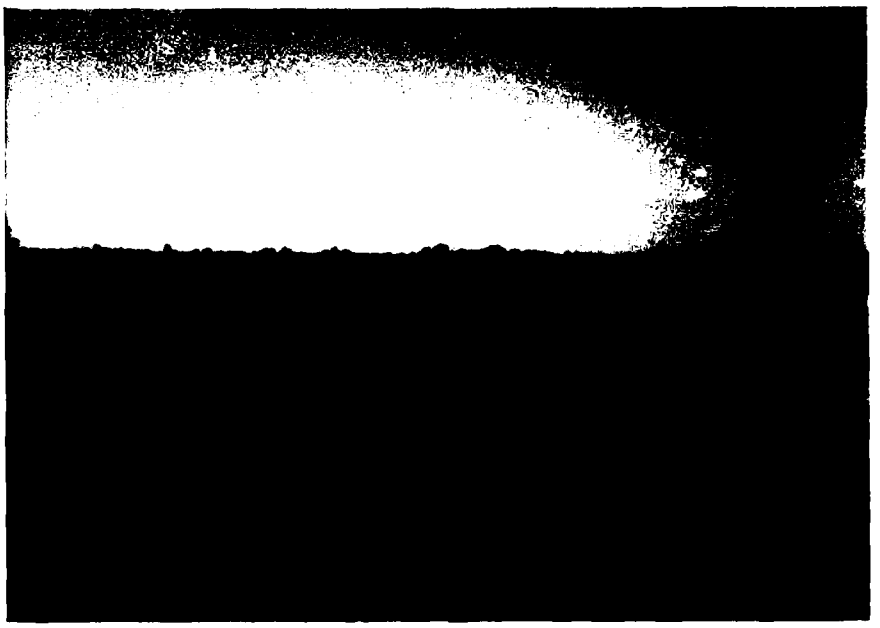


PHOTO 3: CREST OF DAM LOOKING WEST

PHOTO 4: CREST OF DAM LOOKING EAST

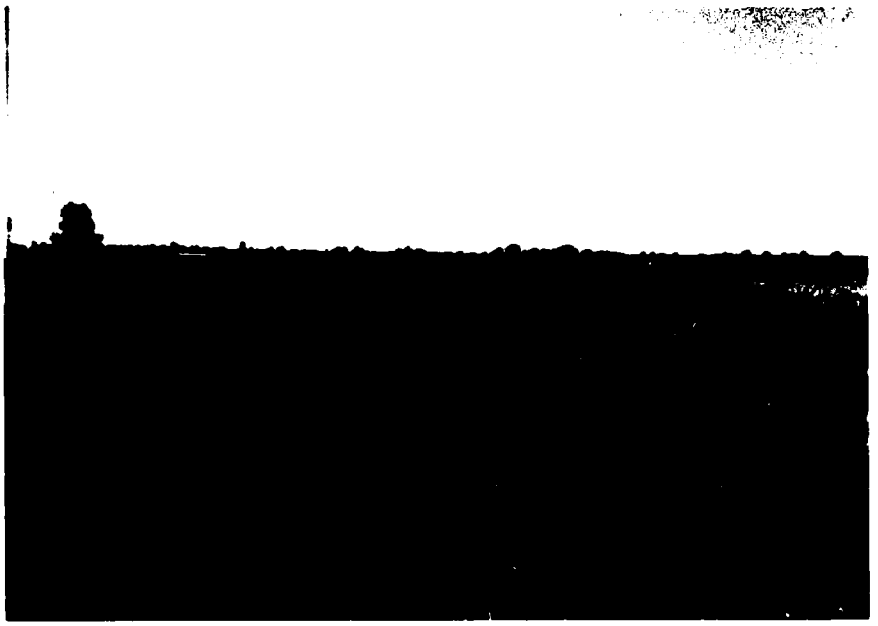


PHOTO 5: DOWNSTREAM SLOPE OF DAM LOOKING WEST

PHOTO 6: DOWNSTREAM SLOPE OF DAM LOOKING EAST

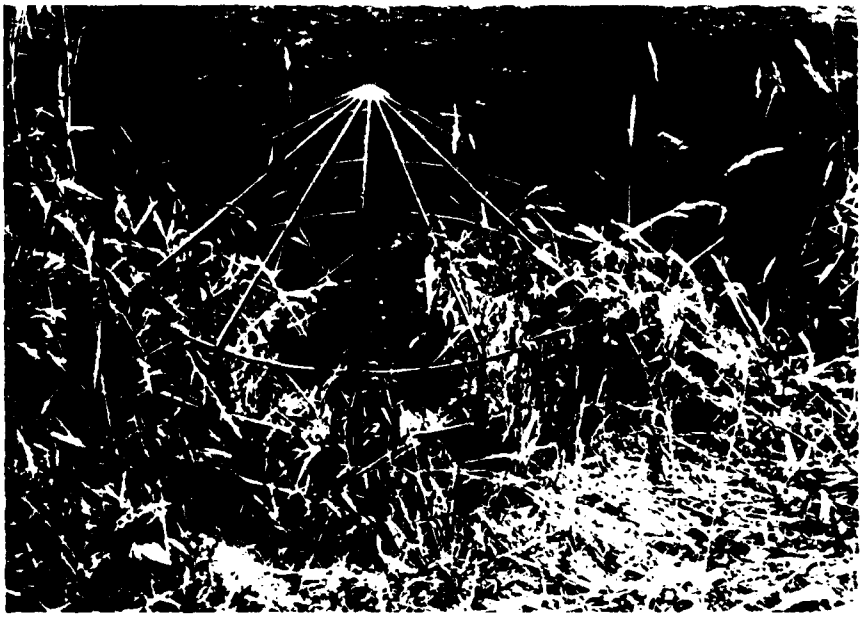


PHOTO 7: PRINCIPAL SPILLWAY DROP INLET

PHOTO 8: PRINCIPAL SPILLWAY OUTLET PIPE

PHOTO 9: PRINCIPAL SPILLWAY PLUNGE POOL AND DOWNSTREAM CHANNEL

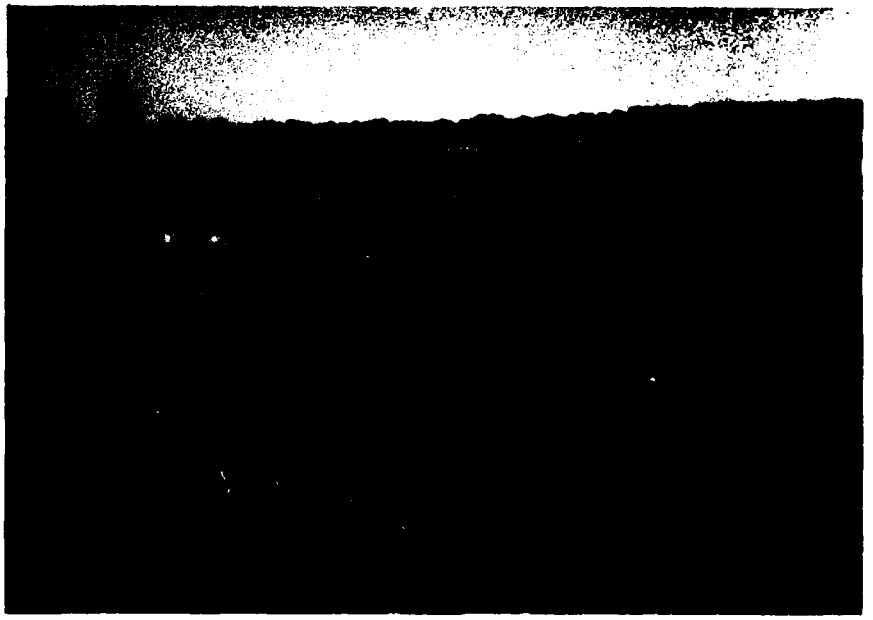


PHOTO 10: EMERGENCY SPILLWAY LOOKING UPSTREAM

PHOTO 11: EMERGENCY SPILLWAY LOOKING DOWNSTREAM

PHOTO 12: EROSION ALONG UPSTREAM FACE OF DAM

PHOTO 13: EROSION ON UPSTREAM FACE OF DAM

PHOTO 14: ANIMAL BURROW ON UPSTREAM FACE OF DAM

APPENDIX A

HYDROLOGIC AND HYDRAULIC ANALYSES

HYDROLOGIC AND HYDRAULIC ANALYSES

To determine the overtopping potential, flood routings were performed by applying the Probable Maximum Precipitation (PMP) to a synthetic unit hydrograph to develop the inflow hydrograph. The inflow hydrograph was then routed through the reservoir and spillways. The overtopping analysis was determined using the computer program HEC-1 (Dam Safety Version) (1).

The PMP was determined from regional charts prepared by the National Weather Service in "Hydrometeorological Report No. 33" (HMR-33). Reduction factors were not applied. The rainfall distribution for the 24-hour PMP storm was determined according to the procedures outlined in HMR-33 and EM 1110-2-1411. The Kansas City, Missouri rainfall distribution (5 min. interval - 24 hours duration), as provided by the St. Louis District, Corp of Engineers, was used when the one percent chance probability flood was routed through the reservoir and spillways.

The synthetic unit hydrograph for the watershed was developed by the computer program using the Soil Converation Service (SCS) method. The parameters for the unit hydrograph are shown in Table 1.

The SCS curve number (CN) method was used in computing the infiltration losses for rainfall-runoff relationship. The CN values used, and the result from the computer output, are shown in Table 2.

The reservoir routing was performed using the Modified Puls Method. The initial reservoir pool elevation for the routing of each storm was determined to be equivalent to the pipe invert elevation of the principal spillway at elevation 894.0 feet m.s.l. in accordance with antecedent storm conditions preceding the one percent probability and probable maximum storms outlined by the U.S. Army Corps of Engineers, St. Louis District (2). The hydraulic capacity of the spillway and the storage capacity of the reservoir were defined by the elevation, surface area, storage, and discharge relationships shown in Table 3.

The rating curve for the spillways is shown in Table 4. The flow over the crest of the dam was determined using the nonlevel dam crest option ($L and $V cards) of the HEC-1 program. The program assumes critical flow over a broad-crested weir. The flow through the principal spillway was determined from weir and pipe flow equations. It was assumed that the inlet is kept free of debris. The flow through the emergency spillway was based on SCS E&WP Unit Design Memo #7.

The result of the routing analyses indicates that 20 percent of the PMF will not overtop the dam.

A summary of the routing analysis for different ratios of the PMF is shown in Table 5.

The computer input data and a summary of the output data are presented at the back of this appendix.

'As-Built' drawings and Hydrologic-Hydraulic design data were made available by the SCS, Columbia, Missouri.

TABLE 1

SYNTHETIC UNIT HYDROGRAPH

Parameters:

Drainage Area (A)	425 acres
Lag Time (L_g)	0.32 hours (AMC II and AMC III)
Time of concentration (T_c)	32 minutes 0.54 hours (AMC II and AMC III)
Duration (D)	4 min. (AMC II and AMC III) (use 5 minutes in each case)

Time (Min.) *	Discharge (cfs) *
0	0
5	112
10	359
15	710
20	874
25	844
30	699
35	482
40	321
45	223
50	155
55	106
60	72
65	49
70	34
75	24
80	16
85	11
90	8

* From HEC-1 computer output

TABLE 1
(Continued)

FORMULAS USED:

T_c was obtained from SCS 'As-Built' watershed data.

$L_g = 0.6\ T_c$

$D = 0.133\ T_c$

TABLE 2

RAINFALL-RUNOFF VALUES

Selected Storm Event	Storm Duration (Hours)	Rainfall (Inches)	Runoff (Inches)	Loss (Inches)
PMP	24	32.24	30.94	1.30

Additional Data:

1) SCS Runoff Curve CN = 90 (AMC III) for the PMF (3).
2) SCS Runoff Curve CN = 78 (AMC II) for the one percent probability flood (From SCS 'As-Built' data).

TABLE 3

ELEVATION, SURFACE AREA, STORAGE, AND DISCHARGE RELATIONSHIPS

Elevation (feet-MSL)	Lake Surface Area (acres)	Lake Storage (acre-ft)	Spillway Discharge (cfs)
*894.0	18.6	98	0
**897.3	28.2	174	42
***899.6	36.0	248	316

*Principal spillway inlet crest elevation
**Emergency spillway crest elevation
***Top of dam elevation

The relationships in Table 3 were developed from the SCS 'As-Built' data and the field measurements.

TABLE 4

SPILLWAY RATING CURVE

Reservoir Elevation (ft-msl)	Principal Spillway Discharge (cfs)	Emergency Spillway Discharge (cfs)	Total Spillway Discharges (cfs)
894.0	0	-	0
895.0	29	-	29
896.0	41	-	41
*897.3	42	0	42
898.3	43	40	83
**899.6	46	270	316

*Emergency Spillway Crest Elevation
**Top of Dam Elevation

METHOD USED:

Principal spillway release rates were determined from SCS 'As-Built' data which utilized the weir flow and pipe flow equations.

Emergency spillway releases were determined from the SCS 'As-Built' data which utilized SCS E & WP Unit Design Memo #7. Extrapolation of the SCS data was used to determine the discharge at elevations above 899.5 feet m.s.l.

TABLE 5

RESULTS OF FLOOD ROUTINGS

Ratio of PMF	Peak Inflow (CFS)	Peak Lake Elevation (ft.-MSL)	Total Storage (AC.-FT.)	Peak Outflow (CFS)	Depth (ft.) Over Top of Dam
-	0	*894.0	90	0	-
0.20	1,161	899.3	237	227	0
0.50	2,902	900.5	283	2,690	0.9
1.00	5,803	901.0	303	5,519	1.4

* Principal spillway inlet crest elevation

BIBLIOGRAPHY

(1) U.S. Army Corps of Engineers, Hydrologic Engineering Center, Flood Hydrograph Package (HEC-1), Dam Safety Version, July 1978, Davis, California.

(2) U.S. Army Corps of Engineers, St. Louis District, Hydrologic/ Hydraulic Standards, Phase I Safety Inspection of Non-Federal Dams, 12 December 1979.

(3) U.S. Department of Agriculture, Soil Conservation Service, National Engineer Handbook, Section 4, Hydrology, August 1972.

(4) U.S. Department of Agriculture, Soil Conservation Service, Soil Survey Interpretations and Field Maps, 1980.

(5) Mary H. McCracken, Missouri Division of Geological Survey, Geologic Map of Missouri, 1961.

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      2.        00    @BANNER MAIL,RUTHERFORD,05C9
      3.        00    @PROG H21/02-0
      4.        00    * H21 02-0 9166
      5.        00    A1      MISSOURI DAM INSPECTIONS
      6.        00    A2      JOHNSON COUNTY DAM A-26
      7.        00    A3      PMP ROUTINGS
      8.        00    B    288                 5                                  3
      9.        00    B1    5
     10.        01    J     1       5       1
     11.        01    J10.2   0.25    0.3     0.5     1.0
     12.        00    K           HEAD
     13.        00    K1      PMF AND RATIOS HYDROGRAPHS ABOVE LAKE
     14.        00    M     1       20.66                       1.0
     15.        00    P       24.8    101.    120.    130.
     16.        00    T                                         -1.     -90.
     17.        00    W2      0.32
     18.        00    X               1.
     19.        00    K     1     DAM                                 1
     20.        00    K1      ROUTE HYDROGRAPHS THROUGH DAM
     21.        00    V                               1       1
     22.        00    Y1    1                                       -894.       -1
     23.        00    Y4894.  895.    896.    897.    898.3   898.7   899.2   899.5   902.    905.
     24.        00    Y50.    29.     41.     42.     83.     124.    204.    285.    1050.   2650.
     25.        00    $590.   140.    193.    262.    345.    500.
     26.        00    $E894.  896.    898.    900.    902.    905.
     27.        00    $$894.
     28.        00    $D899.6
     29.        00    $L0.    455.    1220.   1220.
     30.        00    $V899.6 899.8   900.    905.
     31.        00    K     99
     32.        00    A
     33.        00    A
     34.        00    A
     35.        00    A
     36.        00    A
     37.        00    @FIN

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@END
@END IGNORED - IN CONTROL MODE
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FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 06 FEB 80

MISSOURI DAM INSPECTIONS
JOHNSON COUNTY DAM A-26
PMP ROUTINGS

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	5	0	0	0	0	0	3	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 5 LRTIO= 1
RTIOS= .20 .25 .30 .50 1.00

SUB-AREA RUNOFF COMPUTATION

PMF AND RATIOS HYDROGRAPHS ABOVE LAKE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
HEAD	0	0	0	0	0	0	0	0

HYDROGRAPH DATA

IHYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	.66	.00	.66	1.00	.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
.00	24.80	101.00	120.00	130.00	.00	.00	.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	.00	.00	1.00	.00	.00	1.00	-1.00	-90.00	.00	.00

CURVE NO = -90.00 WETNESS = -1.00 EFFECT CN = 90.00

UNIT HYDROGRAPH DATA
TC= .00 LAG= .32

RECESSION DATA
STRTQ= .00 QRCSN= .00 RTIOR= 1.00

UNIT HYDROGRAPH 21 END OF PERIOD ORDINATES, TC= .00 HOURS, LAG= .32 VOL= 1.00

112.	359.	710.	874.	844.	699.	482.	321.	223.	155.
106.	72.	49.	34.	24.	16.	11.	8.	6.	3.
1.									

0 END-OF-PERIOD FLOW

FLOOD HYDROGRAPH PACKAGE - HEC-1 PROGRAM H21/02-0U TIME 13:29:28 CASE

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.05	1	.01	.00	.01	0.	1.01	12.05	145	.21	.20	.01	340.
1.01	.10	2	.01	.00	.01	0.	1.01	12.10	146	.21	.20	.01	390.
1.01	.15	3	.01	.00	.01	0.	1.01	12.15	147	.21	.20	.01	489.
1.01	.20	4	.01	.00	.01	0.	1.01	12.20	148	.21	.20	.00	611.
1.01	.25	5	.01	.00	.01	0.	1.01	12.25	149	.21	.20	.00	730.
1.01	.30	6	.01	.00	.01	0.	1.01	12.30	150	.21	.20	.00	828.
1.01	.35	7	.01	.00	.01	0.	1.01	12.35	151	.21	.20	.00	897.
1.01	.40	8	.01	.00	.01	0.	1.01	12.40	152	.21	.20	.00	942.
1.01	.45	9	.01	.00	.01	0.	1.01	12.45	153	.21	.21	.00	975.
1.01	.50	10	.01	.00	.01	0.	1.01	12.50	154	.21	.21	.00	997.
1.01	.55	11	.01	.00	.01	0.	1.01	12.55	155	.21	.21	.00	1013.
1.01	1.00	12	.01	.00	.01	0.	1.01	13.00	156	.21	.21	.00	1024.
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1.01	1.15	15	.01	.00	.01	0.	1.01	13.15	159	.25	.25	.00	1091.
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1.01	1.30	18	.01	.00	.01	0.	1.01	13.30	162	.25	.25	.00	1198.
1.01	1.35	19	.01	.00	.01	0.	1.01	13.35	163	.25	.25	.00	1219.
1.01	1.40	20	.01	.00	.01	1.	1.01	13.40	164	.25	.25	.00	1234.
1.01	1.45	21	.01	.00	.01	2.	1.01	13.45	165	.25	.25	.00	1244.
1.01	1.50	22	.01	.00	.01	3.	1.01	13.50	166	.25	.25	.00	1251.
1.01	1.55	23	.01	.00	.01	4.	1.01	13.55	167	.25	.25	.00	1256.
1.01	2.00	24	.01	.00	.01	5.	1.01	14.00	168	.25	.25	.00	1260.
1.01	2.05	25	.01	.00	.01	6.	1.01	14.05	169	.31	.31	.00	1269.
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1.01	2.15	27	.01	.00	.01	9.	1.01	14.15	171	.31	.31	.00	1339.
1.01	2.20	28	.01	.00	.01	10.	1.01	14.20	172	.31	.31	.00	1395.
1.01	2.25	29	.01	.00	.01	12.	1.01	14.25	173	.31	.31	.00	1448.
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1.01	2.55	35	.01	.00	.01	19.	1.01	14.55	179	.31	.31	.00	1575.
1.01	3.00	36	.01	.00	.01	20.	1.01	15.00	180	.31	.31	.00	1580.
1.01	3.05	37	.01	.00	.01	21.	1.01	15.05	181	.19	.19	.00	1570.
1.01	3.10	38	.01	.01	.01	22.	1.01	15.10	182	.38	.38	.00	1550.
1.01	3.15	39	.01	.01	.01	23.	1.01	15.15	183	.38	.38	.00	1533.
1.01	3.20	40	.01	.01	.01	24.	1.01	15.20	184	.57	.57	.00	1583.
1.01	3.25	41	.01	.01	.01	25.	1.01	15.25	185	.67	.66	.00	1725.
1.01	3.30	42	.01	.01	.01	26.	1.01	15.30	186	1.62	1.61	.01	2076.
1.01	3.35	43	.01	.01	.01	27.	1.01	15.35	187	2.67	2.66	.01	2841.
1.01	3.40	44	.01	.01	.01	27.	1.01	15.40	188	1.05	1.04	.00	4004.
1.01	3.45	45	.01	.01	.01	28.	1.01	15.45	189	.67	.66	.00	5200.
1.01	3.50	46	.01	.01	.01	29.	1.01	15.50	190	.57	.57	.00	5803.
1.01	3.55	47	.01	.01	.01	30.	1.01	15.55	191	.38	.38	.00	5738.
1.01	4.00	48	.01	.01	.01	31.	1.01	16.00	192	.38	.38	.00	5181.
1.01	4.05	49	.01	.01	.01	31.	1.01	16.05	193	.29	.29	.00	4370.
1.01	4.10	50	.01	.01	.01	32.	1.01	16.10	194	.29	.29	.00	3636.
1.01	4.15	51	.01	.01	.01	33.	1.01	16.15	195	.29	.29	.00	3054.
1.01	4.20	52	.01	.01	.01	33.	1.01	16.20	196	.29	.29	.00	2598.
1.01	4.25	53	.01	.01	.01	34.	1.01	16.25	197	.29	.29	.00	2259.

1.01	4.30	54	.01	.01	.01	35.	1.01	16.30	198	.29	.29	.00	2017.
1.01	4.35	55	.01	.01	.01	35.	1.01	16.35	199	.29	.29	.00	1850.
1.01	4.40	56	.01	.01	.01	36.	1.01	16.40	200	.29	.29	.00	1738.
1.01	4.45	57	.01	.01	.01	37.	1.01	16.45	201	.29	.29	.00	1661.
1.01	4.50	58	.01	.01	.01	37.	1.01	16.50	202	.29	.29	.00	1608.
1.01	4.55	59	.01	.01	.01	38.	1.01	16.55	203	.29	.29	.00	1572.
1.01	5.00	60	.01	.01	.01	38.	1.01	17.00	204	.29	.29	.00	1547.
1.01	5.05	61	.01	.01	.01	39.	1.01	17.05	205	.23	.23	.00	1522.
1.01	5.10	62	.01	.01	.01	39.	1.01	17.10	206	.23	.23	.00	1485.
1.01	5.15	63	.01	.01	.01	40.	1.01	17.15	207	.23	.23	.00	1429.
1.01	5.20	64	.01	.01	.01	40.	1.01	17.20	208	.23	.23	.00	1368.
1.01	5.25	65	.01	.01	.01	41.	1.01	17.25	209	.23	.23	.00	1312.
1.01	5.30	66	.01	.01	.01	41.	1.01	17.30	210	.23	.23	.00	1267.
1.01	5.35	67	.01	.01	.01	42.	1.01	17.35	211	.23	.23	.00	1236.
1.01	5.40	68	.01	.01	.01	42.	1.01	17.40	212	.23	.23	.00	1216.
1.01	5.45	69	.01	.01	.01	43.	1.01	17.45	213	.23	.23	.00	1202.
1.01	5.50	70	.01	.01	.00	43.	1.01	17.50	214	.23	.23	.00	1192.
1.01	5.55	71	.01	.01	.00	43.	1.01	17.55	215	.23	.23	.00	1185.
1.01	6.00	72	.01	.01	.00	44.	1.01	18.00	216	.23	.23	.00	1181.
1.01	6.05	73	.07	.04	.02	48.	1.01	18.05	217	.02	.02	.00	1154.
1.01	6.10	74	.07	.04	.02	61.	1.01	18.10	218	.02	.02	.00	1077.
1.01	6.15	75	.07	.05	.02	86.	1.01	18.15	219	.02	.02	.00	928.
1.01	6.20	76	.07	.05	.02	118.	1.01	18.20	220	.02	.02	.00	745.
1.01	6.25	77	.07	.05	.02	150.	1.01	18.25	221	.02	.02	.00	568.
1.01	6.30	78	.07	.05	.02	178.	1.01	18.30	222	.02	.02	.00	421.
1.01	6.35	79	.07	.05	.02	199.	1.01	18.35	223	.02	.02	.00	320.
1.01	6.40	80	.07	.05	.01	215.	1.01	18.40	224	.02	.02	.00	253.
1.01	6.45	81	.07	.05	.01	227.	1.01	18.45	225	.02	.02	.00	207.
1.01	6.50	82	.07	.05	.01	237.	1.01	18.50	226	.02	.02	.00	176.
1.01	6.55	83	.07	.05	.01	245.	1.01	18.55	227	.02	.02	.00	152.
1.01	7.00	84	.07	.05	.01	252.	1.01	19.00	228	.02	.02	.00	137.
1.01	7.05	85	.07	.05	.01	258.	1.01	19.05	229	.02	.02	.00	127.
1.01	7.10	86	.07	.05	.01	263.	1.01	19.10	230	.02	.02	.00	120.
1.01	7.15	87	.07	.06	.01	267.	1.01	19.15	231	.02	.02	.00	115.
1.01	7.20	88	.07	.06	.01	271.	1.01	19.20	232	.02	.02	.00	112.
1.01	7.25	89	.07	.06	.01	274.	1.01	19.25	233	.02	.02	.00	109.
1.01	7.30	90	.07	.06	.01	277.	1.01	19.30	234	.02	.02	.00	108.
1.01	7.35	91	.07	.06	.01	280.	1.01	19.35	235	.02	.02	.00	106.
1.01	7.40	92	.07	.06	.01	283.	1.01	19.40	236	.02	.02	.00	106.
1.01	7.45	93	.07	.06	.01	285.	1.01	19.45	237	.02	.02	.00	105.
1.01	7.50	94	.07	.06	.01	287.	1.01	19.50	238	.02	.02	.00	105.
1.01	7.55	95	.07	.06	.01	289.	1.01	19.55	239	.02	.02	.00	105.
1.01	8.00	96	.07	.06	.01	291.	1.01	20.00	240	.02	.02	.00	105.
1.01	8.05	97	.07	.06	.01	293.	1.01	20.05	241	.02	.02	.00	105.
1.01	8.10	98	.07	.06	.01	295.	1.01	20.10	242	.02	.02	.00	105.
1.01	8.15	99	.07	.06	.01	296.	1.01	20.15	243	.02	.02	.00	105.
1.01	8.20	100	.07	.06	.01	298.	1.01	20.20	244	.02	.02	.00	105.
1.01	8.25	101	.07	.06	.01	299.	1.01	20.25	245	.02	.02	.00	105.
1.01	8.30	102	.07	.06	.01	300.	1.01	20.30	246	.02	.02	.00	105.
1.01	8.35	103	.07	.06	.01	302.	1.01	20.35	247	.02	.02	.00	105.
1.01	8.40	104	.07	.06	.01	303.	1.01	20.40	248	.02	.02	.00	105.
1.01	8.45	105	.07	.06	.01	304.	1.01	20.45	249	.02	.02	.00	105.
1.01	8.50	106	.07	.06	.00	305.	1.01	20.50	250	.02	.02	.00	105.
1.01	8.55	107	.07	.06	.00	306.	1.01	20.55	251	.02	.02	.00	105.
1.01	9.00	108	.07	.06	.00	307.	1.01	21.00	252	.02	.02	.00	105.
1.01	9.05	109	.07	.06	.00	308.	1.01	21.05	253	.02	.02	.00	105.

1.01	9.10	110	.07	.06	.00	309.	1.01	21.10	254	.02	.02	.00	105.

1.01	9.10	110	.07	.06	.00	309.	1.01	21.10	254	.02	.02	.00	105.
1.01	9.15	111	.07	.06	.00	310.	1.01	21.15	255	.02	.02	.00	105.
1.01	9.20	112	.07	.06	.00	310.	1.01	21.20	256	.02	.02	.00	105.
1.01	9.25	113	.07	.06	.00	311.	1.01	21.25	257	.02	.02	.00	105.
1.01	9.30	114	.07	.06	.00	312.	1.01	21.30	258	.02	.02	.00	105.
1.01	9.35	115	.07	.06	.00	312.	1.01	21.35	259	.02	.02	.00	105.
1.01	9.40	116	.07	.06	.00	313.	1.01	21.40	260	.02	.02	.00	105.
1.01	9.45	117	.07	.06	.00	314.	1.01	21.45	261	.02	.02	.00	105.
1.01	9.50	118	.07	.06	.00	314.	1.01	21.50	262	.02	.02	.00	105.
1.01	9.55	119	.07	.06	.00	315.	1.01	21.55	263	.02	.02	.00	105.
1.01	10.00	120	.07	.06	.00	315.	1.01	22.00	264	.02	.02	.00	105.
1.01	10.05	121	.07	.06	.00	316.	1.01	22.05	265	.02	.02	.00	105.
1.01	10.10	122	.07	.06	.00	316.	1.01	22.10	266	.02	.02	.00	105.
1.01	10.15	123	.07	.06	.00	317.	1.01	22.15	267	.02	.02	.00	105.
1.01	10.20	124	.07	.06	.00	317.	1.01	22.20	268	.02	.02	.00	105.
1.01	10.25	125	.07	.06	.00	318.	1.01	22.25	269	.02	.02	.00	105.
1.01	10.30	126	.07	.06	.00	318.	1.01	22.30	270	.02	.02	.00	105.
1.01	10.35	127	.07	.06	.00	319.	1.01	22.35	271	.02	.02	.00	105.
1.01	10.40	128	.07	.06	.00	319.	1.01	22.40	272	.02	.02	.00	105.
1.01	10.45	129	.07	.06	.00	319.	1.01	22.45	273	.02	.02	.00	105.
1.01	10.50	130	.07	.06	.00	320.	1.01	22.50	274	.02	.02	.00	105.
1.01	10.55	131	.07	.06	.00	320.	1.01	22.55	275	.02	.02	.00	105.
1.01	11.00	132	.07	.06	.00	320.	1.01	23.00	276	.02	.02	.00	105.
1.01	11.05	133	.07	.06	.00	321.	1.01	23.05	277	.02	.02	.00	105.
1.01	11.10	134	.07	.06	.00	321.	1.01	23.10	278	.02	.02	.00	105.
1.01	11.15	135	.07	.06	.00	321.	1.01	23.15	279	.02	.02	.00	105.
1.01	11.20	136	.07	.06	.00	322.	1.01	23.20	280	.02	.02	.00	105.
1.01	11.25	137	.07	.06	.00	322.	1.01	23.25	281	.02	.02	.00	105.
1.01	11.30	138	.07	.06	.00	322.	1.01	23.30	282	.02	.02	.00	105.
1.01	11.35	139	.07	.06	.00	323.	1.01	23.35	283	.02	.02	.00	105.
1.01	11.40	140	.07	.06	.00	323.	1.01	23.40	284	.02	.02	.00	105.
1.01	11.45	141	.07	.06	.00	323.	1.01	23.45	285	.02	.02	.00	105.
1.01	11.50	142	.07	.06	.00	323.	1.01	23.50	286	.02	.02	.00	105.
1.01	11.55	143	.07	.06	.00	324.	1.01	23.55	287	.02	.02	.00	105.
1.01	12.00	144	.07	.06	.00	324.	1.02	.00	288	.02	.02	.00	105.
									SUM	32.24	30.94	1.30	157557.
										(819.)	(786.)	(33.)	(4461.52)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	5803.	1740.	547.	547.	157535.
CMS	164.	49.	15.	15.	4461.
INCHES		24.52	30.84	30.84	30.84
MM		622.93	783.30	783.30	783.30
AC-FT		863.	1085.	1085.	1085.
THOUS CU M		1064.	1338.	1338.	1338.

HYDROGRAPH AT STA HEAD FOR PLAN 1, RTIO 1

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1161.	348.	109.	109.	31507.
CMS	33.	10.	3.	3.	892.
INCHES		4.90	6.17	6.17	6.17
MM		124.59	156.66	156.66	156.66

HYDROGRAPH ROUTING

ROUTE HYDROGRAPHS THROUGH DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
DAM	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
.0	.000	.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	.000	.000	.000	-894.	-1

STAGE	894.00	895.00	896.00	897.00	898.30	898.70	899.20	899.50	902.00	905.00
FLOW	.00	29.00	41.00	42.00	83.00	124.00	204.00	285.00	1050.00	2650.00
CAPACITY=	90.	140.	193.	262.	345.	500.				
ELEVATION=	894.	896.	898.	900.	902.	905.				

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
894.0	.0	.0	.0	.0	.0	.0	.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
899.6	.0	.0	0.

CREST LENGTH AT OR BELOW ELEVATION	0.	455.	1220.	1220.
	899.6	899.8	900.0	905.0

STATION DAM, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	3.	3.	3.
4.	4.	4.	5.	5.	5.	6.	6.	7.	7.
7.	8.	8.	9.	9.	9.	10.	10.	10.	11.
11.	12.	12.	12.	13.	13.	14.	14.	14.	15.
15.	15.	16.	16.	17.	17.	17.	18.	18.	18.
19.	19.	19.	20.	20.	20.	21.	21.	21.	22.
22.	23.	23.	23.	23.	24.	24.	24.	25.	25.
25.	26.	26.	26.	27.	27.	28.	28.	29.	29.
30.	30.	31.	31.	32.	33.	33.	34.	34.	35.
36.	36.	37.	38.	38.	39.	40.	40.	41.	41.
41.	41.	41.	41.	41.	41.	42.	42.	42.	42.

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .20	RATIO 2 .25	RATIO 3 .30	RATIO 4 .50	RATIO 5 1.00
HYDROGRAPH AT	HEAD	.66	1	1161.	1451.	1741.	2902.	5803.
		(1.71)		(32.87)(	41.08)(	49.30)(	82.17)(	164.33)(
ROUTED TO	DAM	.66	1	227.	428.	1016.	2690.	5519.
		(1.71)		(6.42)(	12.12)(	28.78)(	76.17)(	156.29)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	894.00	894.00	899.60
STORAGE	90.	90.	248.
OUTFLOW	0.	0.	316.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	899.28	.00	237.	227.	.00	18.08	.00
.25	899.81	.21	255.	428.	2.17	16.67	.00
.30	900.09	.49	266.	1016.	2.67	16.17	.00
.50	900.50	.90	283.	2690.	4.17	16.00	.00
1.00	900.99	1.39	303.	5519.	6.42	15.92	.00

APPENDIX B

GEOLOGIC INVESTIGATION AND DESIGN MEMORANDUM

Form SCS-376A
Sheet 1 of _____

10-69

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

GENERAL

State Missouri (County) Johnson SW ¼, NW ¼, Sec 36, T 46N R 29W, Watershed South Fork of Blackwater

Subwatershed _____ Fund class WP-08-7 (FF 2, WP 7, etc.) Site number A-26 Site group III Structure class A

Investigated by Thiel F. Emonds (signature and title) Equipment used Mobile B-40 T.s. (Type, size, make, model, etc.) Date 12/15/65

SITE DATA

Drainage area size .66 sq. mi. 425 acres Type of structure D.I. Purpose Stabilization

Direction of valley trend (downstream) E Maximum height of fill 24.5 feet. Length of fill 1010 feet.

Estimated volume of compacted fill required 22,819 yards

STORAGE ALLOCATION

	Volume (ac. ft.)	Surface Area (acres)	Depth at Dam (feet)
Sediment	32.5	18.6	18.0
Floodwater	146.5	35.5	21.6
_____	_____	_____	_____

SURFACE GEOLOGY AND PHYSIOGRAPHY

Physiographic description Osage Plains Topography rolling Attitude of beds: Dip -0- Strike ---

Steepness of abutments Left 4 percent, Right 3 percent. Width of floodplain at centerline of dam 135 feet

General geology of site.

The shallow overburden is residual material and alluvium. The underlying bedrock is yellowish brown and gray shale belonging to the Marmaton Group of the lower Pennsylvanian System.

Form SCS 3760
sht __ of __

USDA-SCS

18-68

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

FEATURE Principal Spillway, Borrow Area
(Centerline of Dam, Principal Spillway, Emergency Spillway, the Stream Channel, Investigations for Drainage of Structure, Borrow Area, Reservoir Basin, etc.)

DRILLING PROGRAM

Equipment Used	Number of Holes		Number of Samples Taken		
	Exploration	Sampling	Undisturbed (state type)	Disturbed Large	Disturbed Small
B-40 P.A.	2	2		2	
Total	2	2		2	

SUMMARY OF FINDINGS
(Include only factual data)

Shale was encountered in all test holes at depth of 6 to 7 feet. The shale was hardened and dry but the auger was advanced into the shale in each test hole from 2 to 4 feet. All holes bottomed without refusal. There is sufficient borrow available below the crest elevation of the principal spillway with 500 feet of the centerline of fill. Shale outcrops on the left of the channel at the centerline of fill.

Form SCS-376C
Sheet ___ of ___
For In-Service Use Only

USDA-SCS

10-59

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

State Missouri County Johnson Watershed South Fork of Blackwater Subwatershed

Site number A-26 Site group III Structure class a Investigated by N. F. Edmonds (signature and title) Dat. 12/15/64

INTERPRETATIONS AND CONCLUSIONS

The gently sloping abutments are residual soil and in cultivation. The alluvium of the foundation is 6 feet or less in thickness. No evidence of stratification or coarse permeable material was found in Test Holes 301 and 102. The channel has cut to shale and carries only a small amount of bed load except in the inside of meanders where coarse sandy clay occurred to a depth of 5 feet in test hole 302. The shale and/or silt stone on the left of the channel was dry and brittle. The core trench should be extended through the weathered zone of this material or until the shale can be cut without shattering. No other unfavorable foundation conditions were noted.

Borrow Available Area	Sample No.	Topsoil	Cu.Yds. Fill
1		1,250	
	1		12,500
2	1		7,500
3	No.	1,875	18,750

Borrow area 3 was inaccessible and could not be sampled at time of drilling. Estimated to be similar to Area 1

Engineers Recommendations:

1. 90% Standard Compaction
2. Standard Embankment Design - 2½:1 side slopes, 10 ft. berm at normal pool elevation and 12 ft. crown.
3. An overfill allowance of 0.5 of a foot for residual settlement within the fill and foundation.
4. A minimum depth core trench (3-5 feet). The core trench across the stream channel should cut through the weathered shale material as recommended in the geologic report.
5. All materials from required excavations and borrow are classed as CL and are suitable for use in any portion of the structure.

	Ht. Fill	Consolidation
A-24	18.6'	2.7%
E-24	21.5'	2.3%

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-5337
REV. 2-64

WATERSHED: South Fork of Blackwater
SUB-WATERSHED:
SITE NO.: A-26
LOCATION: Johnson County
OWNER:
STATE: Missouri
LOGGED BY: Huel F. Edmonds
DATE: 12/15/64
PROJECT: WP-07 ____ WP-08 -7 ____ FP-09 ____ P.L.-46 ____
DRILLING EQUIPMENT: Mobile B-40
LOCATION OF HOLES: 10+00 B+00

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE INT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES 2 REM. MIN. DIAM	SAMPLES 3 REC. %
101	890.3	0	.5	Top soil		PS								
		.5	7	Clay, yellowish brown, stiff, moist		CL	FA	1	D	1	7			
		7	9	Shale, yellowish brown, dry, hard										
				Total Depth 9' No water level										

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET ___ OF ___ SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-5007
REV. 2-64

WATERSHED: South Fork of Blackwater
SUB-WATERSHED:
SITE NO.: A-26
LOCATION: Johnson County
OWNER:
STATE: Missouri
LOGGED BY: Nuel F. Edmonds
DATE: 12/15/64
PROJECT: WP-07 ____ WP-08-7 ____ FP-09 ____ P.L.-46 ____
DRILLING EQUIPMENT: Mobile 3-40
LOCATION OF HOLES: B+25 B+50

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES 2 REM MIN. DIAM	SAMPLES 3 REC. %
102	885.4	0	5	Silt, clayey, dark grayish brown, moist, medium, alluvium		ML	FA							
		5	6	Clay, silty, grayish, brown		CL	FA	1	D	1	5			
		6	7	Shale, yellowish brown, dry hard										
				Total Depth 7' No water level E.O.D.										

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET ____ OF ____ SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-SSST
REV. 2-64

WATERSHED: South Fork of Blackwater River Watershed	SUB-WATERSHED:	SITE NO.: A-26	
LOCATION: Johnson County	OWNER:	STATE: Missouri	
LOGGED BY: Miel F. Edmonds	DATE: 12/15/64	PROJECT: WP-07 ____ WP-08 -7 ____ FP-03 ____ P.L.-46 ____	
DRILLING EQUIPMENT: Mobile B-40	LOCATION OF HOLES: C. Fill 7+15		

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES 2 REM. MIN. DIAM.	SAMPLES 3 REC. %
301	882.1	0	6	Clay, silty, dark grayish and yellowish brown, slightly moist, stiff, alluvial soil		CL	FA							
		6	8.5	Shale, yellowish brown, dry hard.										
				Total Depth 8.5' No water level E.O.D.										

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET ____ OF ____ SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-ENGR
REV. 2-64

WATERSHED: South Fork of Blackwater
SUB-WATERSHED:
SITE NO.: A-26
LOCATION: Johnson County
OWNER:
STATE: Missouri
LOGGED BY: Muel F. Edmonds
DATE: 12/15/64
PROJECT: WP-07 ____ WP-08 -7 ____ FP-03 ____ P.L.-46 ____
DRILLING EQUIPMENT: Mobile B-40
LOCATION OF HOLES: C.Fill 7+15 75' Rt.

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES 2 REM MIN. DIAM	SAMPLES 3 REC. %
302	875.8	0	2	Silt, clayey, dark brown, moist, soft, alluvium		ML	FA							
		2	5	Clay, gravelly, wet, medium 30% coarse sand and fine gravel channel fill		CL	FA							
		5	9	Shale, yellowish brown, dry, hard.										
				Total Depth 9' Water level 2.5' E.O.D.										

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET ____ OF ____ SHEETS

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA GEN. REG. NO. 27

UNITED STATES GOVERNMENT

Memorandum

TO :Gerald K. McElhiney, Project Engineer, SCS, Warrensburg, Missouri

DATE: January 20, 1965

FROM :William S. Culpepper, State Conservation Engineer SCS, Columbia, Missouri

W.S. Culpepper

SUBJECT: ENGINEERING - Recommendations for the Design of Structures A-26 Blackwater and A-26 Tabo

Since samples were not submitted to the Soil Mechanics Laboratory for these structures, the following recommendations are based on test results for similar site conditions and should be used in preparing the designs.

A-26 - Blackwater

1. 90% Standard Compaction
2. Standard Embankment Design - 2½:1 side slopes, 10 ft. berm at normal pool elevation and 12 ft. crown.
3. An overfill allowance of 0.5 of a foot for residual settlement within the fill and foundation.
4. A minimum depth core trench (3-5 feet). The core trench across the stream channel should cut through the weathered shale material as recommended in the geologic report.
5. All materials from required excavations and borrow are classed as CL and are suitable for use in any portion of the structure.

A-26 - Tabo

1. 90% Standard Compaction
2. Standard embankment design - 2½:1 side slopes, 10 ft. berm at normal pool elevation and 12 ft. crown.
3. An overfill allowance of 1.0 foot for residual settlement within the fill and foundation.
4. A minimum depth core trench (3-5 feet). Core trench across the stream channel should extend approximately 2 feet below the alluvium deposit in the channel.
5. Materials from required excavations and borrow are suitable for use in any portion of the structure.

cc: Neil Randall
Arthur Ison

SCS-359
(11/58)

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
SOIL MECHANICS LABORATORY

WORK SHEET FOR COMPACTION AND PENETRATION RESISTANCE DATA

Laboratory Sample No.: [illegible]

COMPACTION DATA (Record Weights in Pounds)

1	Wt. of Cyl. + Soil	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	Wt. of Cylinder	4.43	4.43	4.43	4.43	4.43	4.43
3	Wt. of Soil = (1) - (2)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	Wt. per Cu. Ft. (Wet) = (3) ÷ Vol. of Cyl.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	Wt. per Cu. Ft. (Dry) = (4) x 100 / 100 + (8)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6	Proctor Needle Readings				\		
7	Size Needle (Sq.in.)						
8	Penetration (Lbs./sq. in.) Resistance = (6) ÷ (7)						

MOISTURE DETERMINATION DATA (Record Weights in Grams)

9	Percent Moisture = (13) / (15)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10	Can Number	1	2	3	01	5	6
11	Wet Wt. - Can + Soil	149.4	144.3	131.6	141.2	131.9	133.2
12	Dry Wt. - Can + Soil	133.1	128.4	116.7	126.2	116.1	119.4
13	Moisture Weight = (11) - (12)	16.3	15.9	14.9	15.0	15.8	13.8
14	Weight of Can	27.3	27.1	27.2	27.5	27.5	27.1
15	Dry Weight of Soil = (12) - (14)	105.8	101.5	89.5	98.7	88.6	92.3

Vol. of Cyl. _____ cu. ft.	
	Standard Proctor
	Modified AASHO
	Other_____

PROCEDURE DATA:

Wt. of Hammer 5.5 Pounds

Drop 12 Inches

No. of Lifts 3

Completed by: [illegible] Date: 1-5-65

Computed by: _____ Date: _____

Checked by. MEH Date: 1-7-65

Recorded by: _____ Date: _____

Project BLACKWATER RIVER

Density		%
Wet	Dry	H_2O
	103.1	17.5

Site A-26

59M-61

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
SOIL MECHANICS LABORATORY

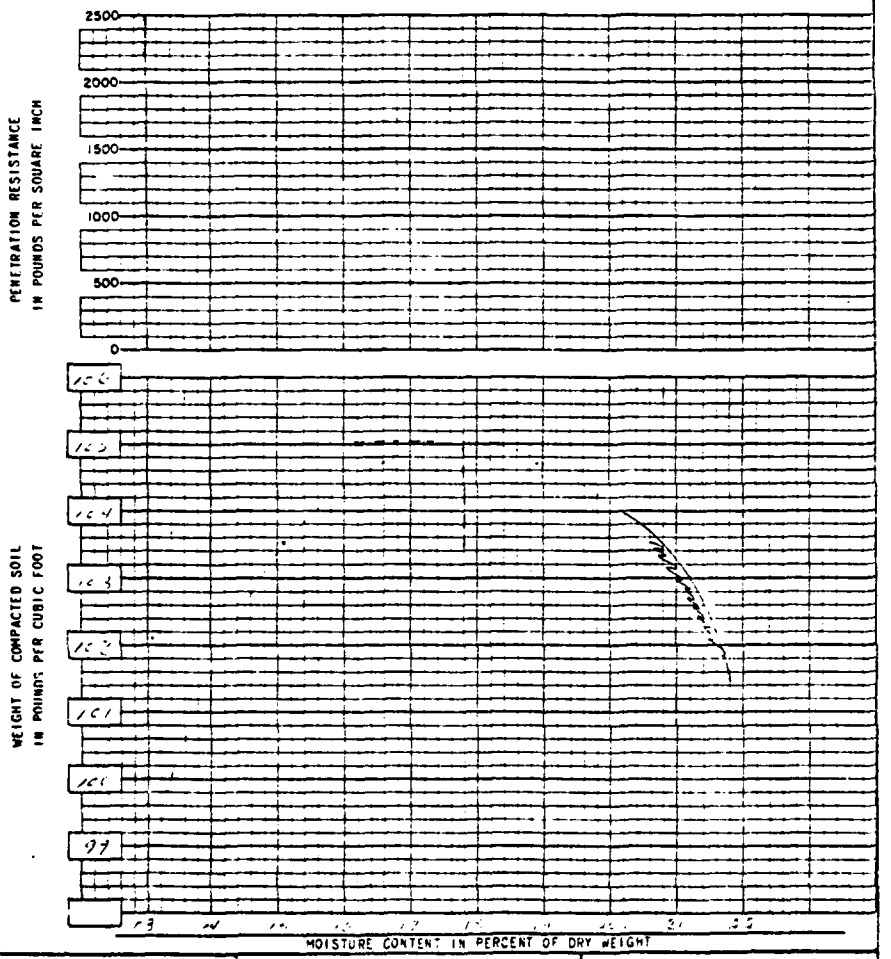
SCS-352 Rev. (10/58)

COMPACTION AND PENETRATION RESISTANCE REPORT

Date _____ Sample No.: Field _____ Lab _____

Project _____ Location _____

Sample Location and Depth _____



TYPE OF TEST	TEST PROCEDURE	Classification
☒ Standard Proctor	Weight of Hammer 5.5 Lbs.	Material compacted represents _____ percent of the sample
☐ Modified AASHO	Drop 12 Inches	and passed _____ sieve
☐ Other _____	Lifts 3	(Sp. Gr.) Soil _____
	Vol. of Cylinder 1/30 Cu.Ft.	Curve _____

SCS-359
(11/58)

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
SOIL MECHANICS LABORATORY

WORK SHEET FOR COMPACTION AND PENETRATION RESISTANCE DATA

Laboratory Sample No.: 102

COMPACTION DATA (Record Weights in Pounds)

1	Wt. of Cyl. + Soil	8.20	8.40	[illegible]	8.55	8.55	8.50
2	Wt. of Cylinder	4.43	4.43	4.43	4.43	4.43	4.43
3	Wt. of Soil = (1) - (2)	3.77	3.97	[illegible]	4.12	4.12	4.07
4	Wt. per Cu. Ft. (Wet) = (3) ÷ Vol. of Cyl.	115.1	119.	133.1	124.5	123.5	124.1
5	Wt. per Cu. Ft. (Dry) = $\frac{(4) \times 100}{100 + (9)}$	99.6	103.5	104.7	104.7	101.5	102.5
6	Proctor Needle Readings						
7	Size Needle (Sq.in.)						
8	Penetration (Lbs./sq. in.) Resistance = (6) ÷ (7)						

MOISTURE DETERMINATION DATA (Record Weights in Grams)

9	Percent Moisture = $\frac{(13)}{(15)}$	13.2	15.1	13.2	18.4	21.8	21.2
10	Can Number	1	2	3	4	5	-
11	Wet Wt. - Can + Soil	149.2	160.3	151.2	[illegible]	171.9	177.5
12	Dry Wt. - Can + Soil	135.1	138.9	131.7	141.2	141.1	151.4
13	Moisture Weight = (11) - (12)	14.3	15.4	14.9	23.5	25.8	26.1
14	Weight of Can	27.3	27.1	27.2	[illegible]	27.5	27.1
15	Dry Weight of Soil = (12) - (14)	107.8	101.8	89.5	118.0	113.6	124.3

Vol. of Cyl. 1/30 cu. ft.	
X	Standard Proctor
	Modified AASHO
	Other

PROCEDURE DATA:

Wt. of Hammer 5.5 Pounds

Drop 12 Inches

No. of Lifts 3

Completed by: CLB Date: 1-5-65

Computed by: _____ Date: _____

Checked by: M.CH Date: 1-7-65

Recorded by: _____ Date: _____

Density		% H_2O
Wet	Dry	
	105.1	17.8

Project BLACKWATER RIVER Site A-26

59M-8:

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
SOIL MECHANICS LABORATORY

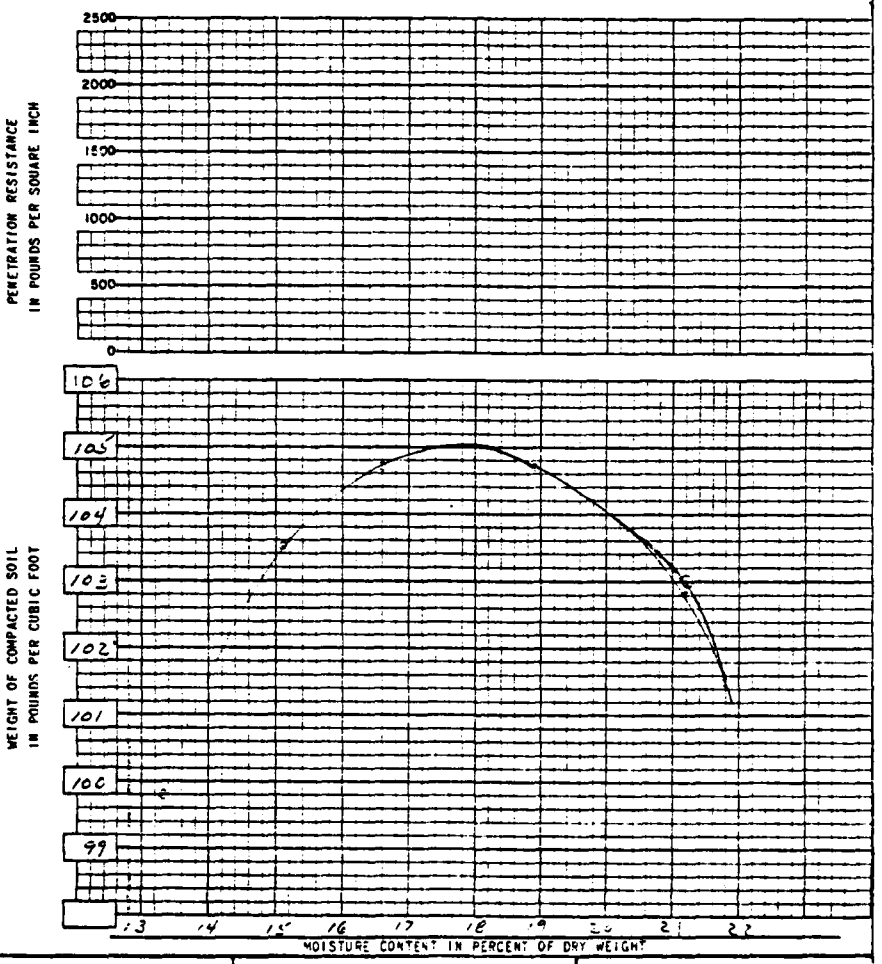
SCS-352 Rev. (10/58)

COMPACTION AND PENETRATION RESISTANCE REPORT

Date 1-6-65 Sample No.: Field 102 Lab

Project BLACK WATER RIVER Location A-26

Sample Location and Depth



TYPE OF TEST	TEST PROCEDURE	Classification
☒ Standard Proctor	Weight of Hammer 5.5 Lbs.	Material compacted represents
☐ Modified AASHO	Drop 12 Inches	____ percent of the sample
☐ Other ____	Lifts 3	and passed ____ sieve
	Vol. of Cylinder 1/30 Cu.Ft.	(Sp. gr.) Dd= 2.98
		Curve ____

SCS-359
(11/58)

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
SOIL MECHANICS LABORATORY

WORK SHEET FOR COMPACTION AND PENETRATION RESISTANCE DATA

Laboratory Sample No.: 101

COMPACTION DATA (Record Weights in Pounds)

1	Wt. of Cyl. + Soil	6.10	6.53	6.62	6.59		
2	Wt. of Cylinder	4.43	4.43	4.43	4.43		
3	Wt. of Soil = (1) − (2)	1.67	2.10	2.19	2.16		
4	Wt. per Cu. Ft. (Wet) = (3) ÷ Vol. of Cyl.	107.1	134.7	140.4	138.5		
5	Wt. per Cu. Ft. (Dry) = $\frac{(4) \times 100}{100 + (9)}$	94.5	105.5	113.2	111.7		
6	Proctor Needle Readings						
7	Size Needle (Sq. in.)						
8	Penetration (Lbs./sq. in.) Resistance = (6) ÷ (7)						

MOISTURE DETERMINATION DATA (Record Weights in Grams)

9	Percent Moisture = $\frac{(13)}{(15)}$	13.4	24.2	21.3	23.4		
10	Can Number	7	2	5	10		
11	Wet Wt. − Can + Soil	139.7	163.6	170.0	165.1		
12	Dry Wt. − Can + Soil	124.1	131.8	140.2	136.0		
13	Moisture Weight = (11) − (12)	15.6	21.2	19.8	29.1		
14	Weight of Can	32.3	29.2	27.1	26.9		
15	Dry Weight of Soil = (12) − (14)	91.8	102.6	113.1	109.1		

Vol. of Cyl. _____ cu. ft.	
	Standard Proctor
	Modified AASHO
	Other_____

PROCEDURE DATA:

Wt. of Hammer 5.5 Pounds

Drop 18 Inches

No. of Lifts 3

Completed by: C.J.P. Date: 1-7-65

Computed by: _____ Date: _____

Checked by: _____ Date: _____

Recorded by: _____ Date: _____

Density		% H_2O
Wet	Dry	
	103.8	20.6

Project BLACKWATER RIVER Site A-26

50M-61

SCS-352 Rev. (10/58)

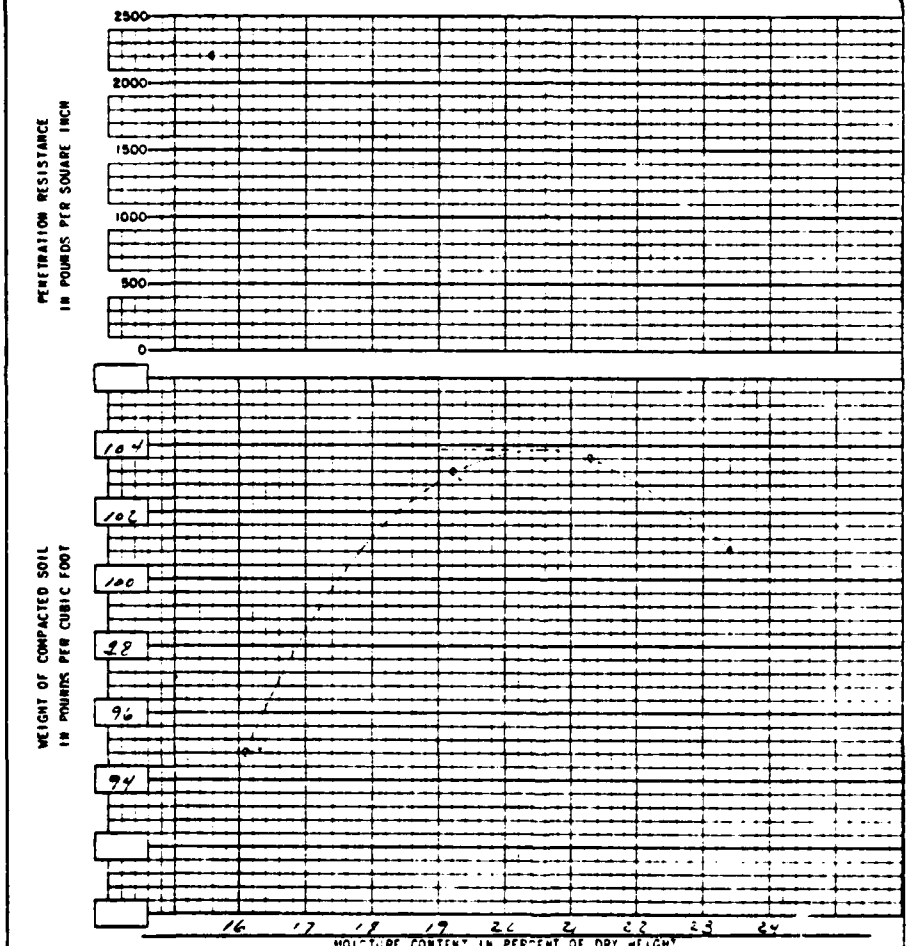
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
SOIL MECHANICS LABORATORY

COMPACTION AND PENETRATION RESISTANCE REPORT

Date 1-7-65 Sample No.: Field 161 Lab

Project BLACKWATER RIVER Location A-20

Sample Location and Depth



TYPE OF TEST	TEST PROCEDURE	Classification
[X] Standard Proctor	Weight of Hammer 5.5 Lbs.	Material compacted represents _____ percent of the sample and passed _____ sieve
[ ] Modified AASHO	Drop 12 Inches	(Sp. Gr.) Gse 2.7*
[ ] Other _____	Lifts 3	Curve _____ of _____
	Vol. of Cylinder 1/3 Cu.Ft.	

SAM-26

SCS-359
(11/58)

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
SOIL MECHANICS LABORATORY

WORK SHEET FOR COMPACTION AND PENETRATION RESISTANCE DATA

Laboratory Sample No.: [illegible]

COMPACTION DATA (Record Weights in Pounds)

1	Wt. of Cyl. + Soil	5.12	5.33	5.62	5.[illegible]		
2	Wt. of Cylinder	4.43	4.43	4.43	4.43		
3	Wt. of Soil = (1) - (2)	.77	.90	1.19	1.[illegible]		
4	Wt. per Cu. Ft. (wet) = (3) ÷ Vol. of Cyl.	[illegible]	[illegible]	[illegible]	[illegible]		
5	Wt. per Cu. Ft. (Dry) = (4) x 100 / 100 + (9)	[illegible]	[illegible]	[illegible]			
6	Proctor Needle Readings						
7	Size Needle (Sq.in.)						
8	Penetration (Lbs./sq. in.) Resistance = (6) ÷ (7)						

MOISTURE DETERMINATION DATA (Record Weights in Grams)

9	Percent Moisture = (13) / (15)	[illegible]	[illegible]	41.3	[illegible]		
10	Can Number	7	5	9	11		
11	Wet Wt. - Can + Soil	139.7	163.6	146.6	162.6		
12	Dry Wt. - Can + Soil	124.1	142.3	126.2	136.9		
13	Moisture Weight = (11) - (12)	15.6	21.3	15.5	25.7		
14	Weight of Can	27.3	27.2	27.1	27.3		
15	Dry Weight of Soil = (12) - (14)	96.8	115.1	93.1	109.6		

Vol. of Cyl. 1/30 cu. ft.	
X	Standard Proctor
	Modified AASHO
	Other _____

PROCEDURE DATA:

Wt. of Hammer 5.2 Pounds

Drop 12 Inches

No. of Lifts 3

Completed by: [illegible] Date: 1-7-65

Computed by: _____ Date: _____

Checked by: _____ Date: _____

Recorded by: _____ Date: _____

Density		% H_2O
Wet	Dry	
	103.8	20.6

Project [illegible] Site A 20

50m-61

SCS-352 Rev. (10/58)

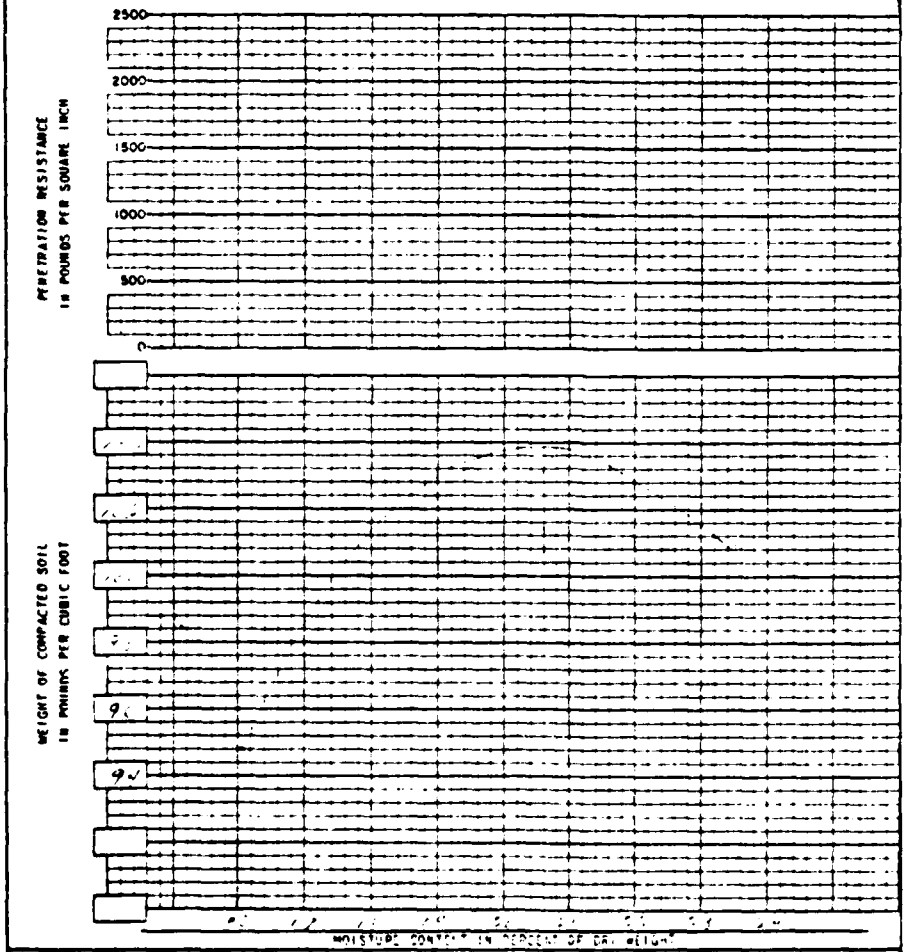
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
SOIL MECHANICS LABORATORY

COMPACTION AND PENETRATION RESISTANCE REPORT

Date _____ Sample No.: Field _____ Lab _____

Project _____ Location _____

Sample Location and Depth _____



TYPE OF TEST	TEST PROCEDURE	Classification
☐ Standard Proctor ☐ Modified AASHO ☐ Other _____	Weight of Hammer _____ Lbs. Drop _____ Inches _____ Cu.Ft. Vol. of Cylinder _____ Cu.Ft.	Material compacted represents _____ percent of the sample and passed _____ sieve _____

APPENDIX C

HYDROLOGIC-HYDRAULIC DESIGN DATA

STRUCTURE DATA

Class of Structure "a" Grade Stabilization
Drainage Area (total) 425 Ac. 0.664 Sq.Mi.
(uncontrolled) 425 Ac. 0.664 Sq.Mi.
Time of Concentration 0.54 Hours
Soil Cover Complex Number 78 For A.M.C. II
Sediment Capacity Available 97.5 Ac.Ft. below Elev. 894.0
Total Sediment Capacity Available 97.5 Ac.Ft.
Capacity Equivalents (Vol.) 2.75 In.
Retarding Capacity Provided 93.7 Ac.Ft.
Capacity Equivalents (Vol.) 2.36 In.
Water Supply Provided None Ac.Ft.-Identify Uses

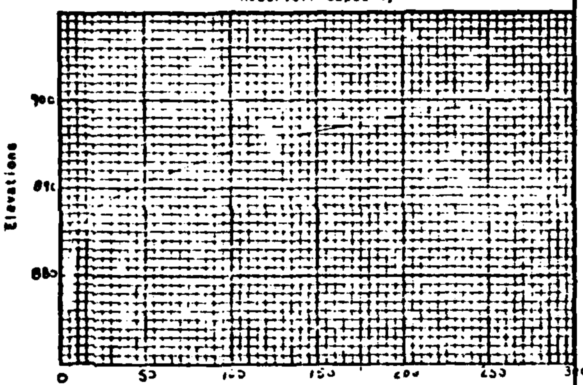
Principal Spillway:
Maximum Capacity ~~(low stage)~~ 43 c.f.s.
~~Maximum Capacity (high stage)~~ ——— c.f.s.
10 Day Drawdown Elev. 894.0

Emergency Spillway:
Percent Chance Use 4 Storm Duration 6 Hour
Type Vegetated Earth "n" Value Used 0.04
Emergency Spillway Hydrograph for Class "a" Structures
Rainfall 5.75 in.
Runoff 3.37 in.
Peak Inflow 518 c.f.s.
Maximum Discharge - Emergency Spillway 35 c.f.s.
Maximum Water Surface Elev. 898.2
Velocity of Flow (Ve) 3.1 f.p.s.

Supplementary Data and Special Design Features:
Principal Spillway Crest Elev. = 894.0
Emergency Spillway Crest Elev. = 897.6
Emergency Spillway Bottom Width = 40'
Settled Top of Dam Elev. = 899.6
11 x 5 = 22 x 181.2 = 3,986

Freeboard Hydrograph for Class "a" Structures
Rainfall 8.29 in.
Runoff 5.46 in.
Peak Inflow 1579 c.f.s.
Maximum Discharge - Emergency Spillway 207 c.f.s.
Maximum Water Surface Elev. 899.4

Reservoir Capacity



Total Storage - Ac.Ft.

Supplementary Data and Special Design Features:

STRUCTURE A-26
Blackwater River Watershed PL-566
Johnson County, Missouri
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE


DA
FIL